

PHOTO-ENGRAVING
A N D
PHOTO-LITHOGRAPHY
B Y
W. T. WILKINSON

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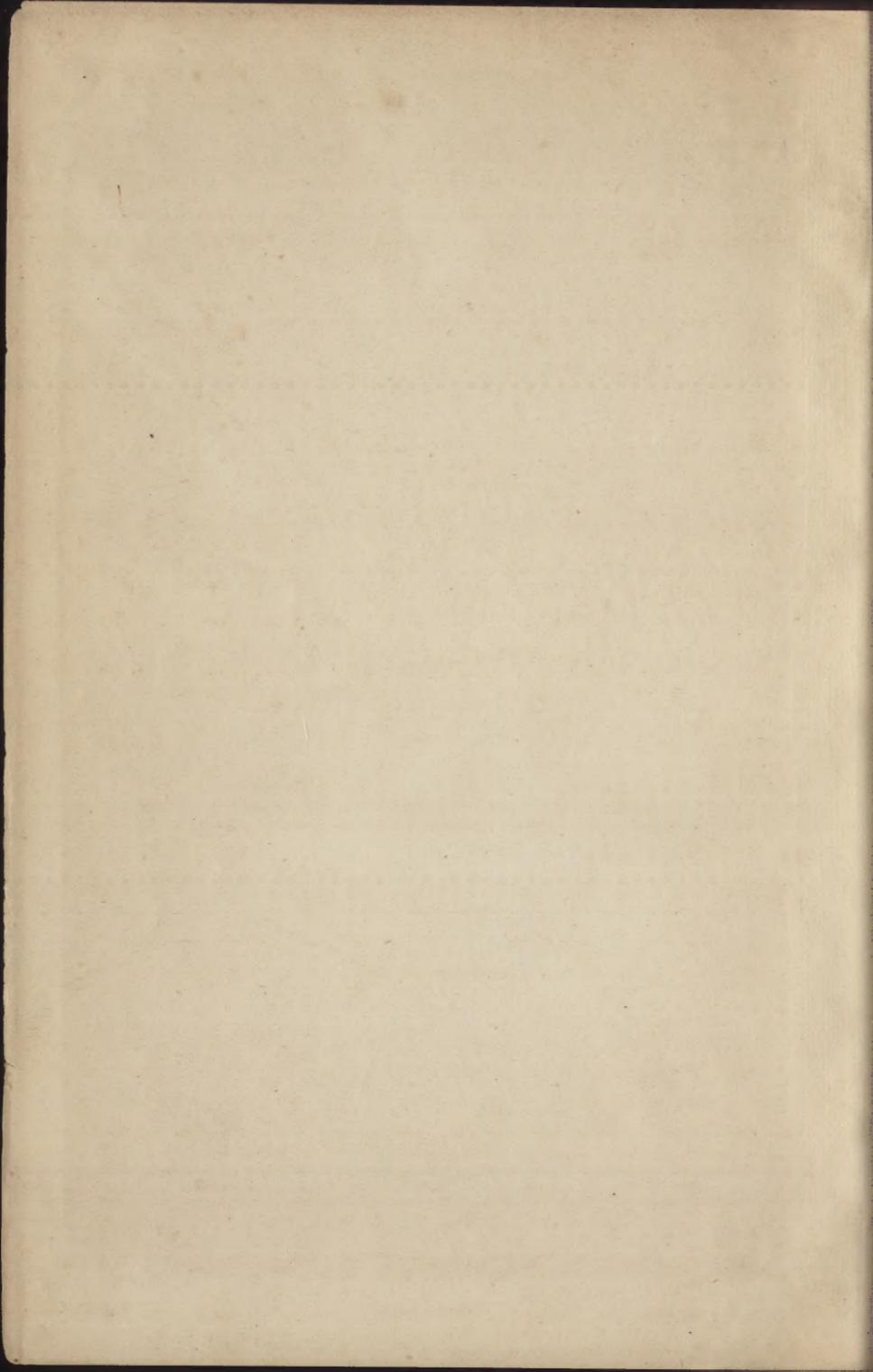


PHOTO-ENGRAVING
ON
ZINC AND COPPER,
IN
LINE AND HALF TONE
AND
PHOTO-LITHOGRAPHY.

A
PRACTICAL MANUAL
BY
W. T. WILKINSON,
WITH AN APPENDIX.

LONDON :
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To the Editors, past and present, of the *Photographic News* and the *British Journal of Photography*, this work is gratefully and respectfully dedicated by the Author.

VALEDICTORY.

INSTEAD of marking this page the Preface, I prefer the title as given, as it must necessarily be written last of all.

This book has been the subject of many anxious experiments, and everything herein printed may be relied on as thoroughly workable.

To the tyro I would strongly recommend, before reading anything else, to carefully peruse Mr. Horgan's article in the Appendix, as that will give him the best idea of what he has to do; and to all who, with the aid of this manual, try to produce printing blocks, &c., if they meet with any difficulties in working, on writing to me I will try and help them out of their difficulties.

I cannot conclude this without gratefully acknowledging the kindness of the Editor and Proprietors of the *Photographic News* in granting permission for the various extracts in the Appendix, and also for the loan of the blocks to illustrate the same.

W. T. WILKINSON.

North Parade,
Otley, Yorkshire.

July 1st, 1886.

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The first thing I did was to go to the library and get a copy of the book "The History of the English Language" by J. R. Green. This book is a good starting point for understanding the history of the English language. It covers the period from the Anglo-Saxons to the present day, and provides a comprehensive overview of the development of the language. The book is well-written and easy to understand, making it a valuable resource for anyone interested in the history of the English language.

PHOTO-ENGRAVING.

INTRODUCTION.

THE subject of making Photographs applicable for the illustration of Letterpress, instead of wood cuts, has occupied the attention of experimentalists since the earliest days of the art-science, as the records of the Patent Office show ; but until the last few years, little or no progress has been made ; in fact until the advantages for cheap and quick productions of the process called Gillotage was demonstrated, very few examples of Phototype blocks offering encouragement to the practical printer were made.

This process of Gillotage was simply a Drawing in line made either direct upon zinc, or transferred to the zinc by ordinary Lithography, the drawing being made upon Litho. transfer paper.

This process answers admirably for original drawings by artists who can draw direct on zinc and work within a given space, but if the drawing has to be very small, or a block is required from a drawing already in existence, and that drawing too large for the contemplated block, then photography was brought in, and from the drawing a negative made the required size, from that negative a photo. litho. transfer printed upon paper coated with gelatine, coated (after exposure) with ink and then developed, this transfer was either laid direct upon the zinc or was first of all transferred to stone, then after touching up, a litho transfer was pulled which was laid down upon zinc and etched in relief.

The next step in progress was the process of printing from a photographic negative direct upon the zinc so securing firmer and better results than when one or two transfers had to be made.

Both these processes are only suitable for the production of pictures in line, so that the printing of a photograph with its smooth gradations of half tones along with letterpress was still as

far off as ever until in 1882-83 when Meisenbach and Brown Barnes and Bell produced some results that fairly showed it was possible to bridge over the difficulties between photo-engraving in line and half tone.

Meisenbach's method of doing this is a secret process, and I will not attempt guessing at it, but that of Brown, Barnes and Bell is attained by embossing a paper photograph with a grain by passing it in contact with a wire gauze, sometimes inked and sometimes not, between powerful rollers, then from the photograph thus embossed a negative is made, from this negative a print is taken on zinc and etched into relief.

The grain thus embossed upon the paper print when photographed upon the zinc fills up the intervals between the lights and black and also binds the half tones, so that when etched a phototypic block in half tone capable of being printed with type is the result.

This process or method is patented 1883 and would not have been thus described but I find that as early as 1855 A. J. Berchtold took out a patent for producing grain by printing in black or any color from a plate or block or other printing surface, or by perforating or making strokes, lines, or dots by roller or other instruments, these perforations going through the photograph or only partly so.

Whilst upon this subject of giving a grain to the photograph for reproduction as a printing block it will be interesting to give the various methods patented at various times with dates.

In 1852 Mr. Fox Talbot in his patent for intaglio blocks described his method of producing a grain by placing muslin, crape, &c., between the positive and sensitive surface or printed the grain first and then the picture. Pretsch 1854 obtained grain by the reticulation of gelatine.

J. W. Swan 1865 made a relief tissue containing charcoal or other inert grit. E. & J. Bullock 1865 published perhaps the most important specification and described all or nearly of the practical methods of obtaining grained photographs.

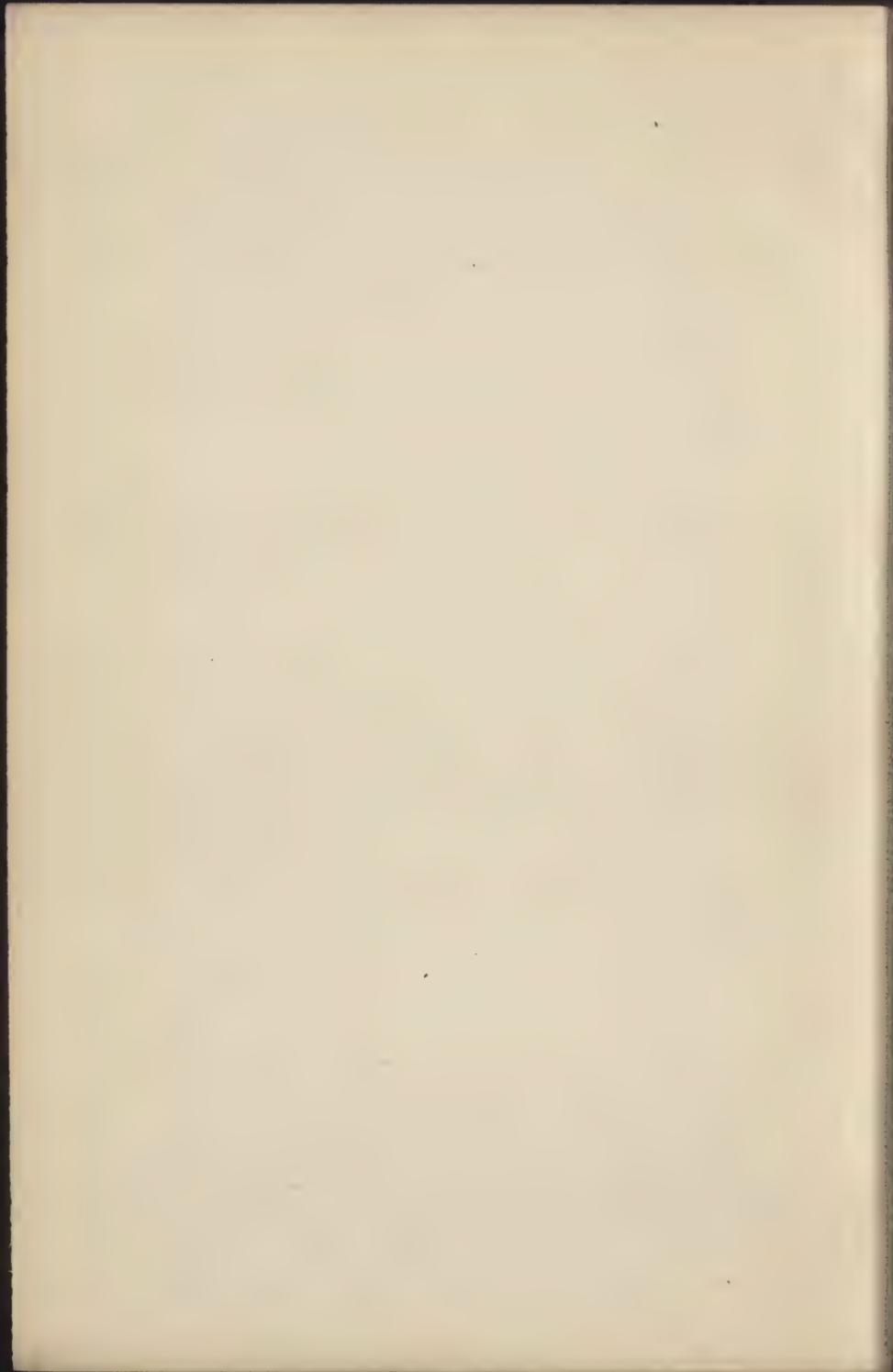
They placed any fine fabric between negative and sensitive surface, or interposed it between camera and object to be photographed, or copies of granulated or reticulated structures or fabrics upon glass &c., were used between negative and sensitive surface or between lens and prepared plate during exposure in the camera ; or such copy may be placed face to face with ordinary negative, both copied together, or by the superposition of grain upon prepared surface and printing image by aid of solar camera.

Since then many other patents have been taken out but the methods were more or less repetitions of the above. In 1879 J. W. Swan makes grained negatives by using a screen in front of sensitive plate and moves this screen during exposure and Meisenbach's specification a little later is to the same end.

Woodbury reliefs can be used for the production of photo-type blocks in a very simple manner, by embossing a piece of ordinary litho. transfer paper with lines, dots or stipple by contact with wire gauze or an engraved plate, then placing in contact with a relief thinly coated with transfer ink and then subjecting them to heavy pressure in type, litho. or hydraulic press, or instead of embossing the transfer paper the wire gauze or engraved plate is placed in bed of press then the litho transfer paper laid upon it (face up) and upon that the inked relief, then upon application of pressure a grained transfer is obtained which may be transferred to zinc and etched in relief.

And now having given full consideration to the theoretical we will now plunge into the practical.

As this treatise is written for those who are both (and neither) photographers and lithographers, it has been deemed the wisest and best course to treat each subject as far as required for the proper working of the processes described in this book in as elementary a manner as possible, so as to serve as a guide to the expert as well as to beginner. In order to simplify matters when treating of the different methods, all the different formula will be given once for all, and under each process reference will be made to the page and section.



CHAPTER I.

LIST OF APPARATUS &c REQUIRED.

Section I.—Photographic Negatives.

THE studio and dark room it will be assumed, are either already built, or if to be built or converted, that most people as a rule will prefer their own model. I will content myself with saying that the studio must possess a floor that is perfectly steady and that the portion where the object to be photographed will be placed is well lighted with a good all round light, and the dark room is fitted with a sink in front of a good sized window covered with a non-actinic medium such as two thicknesses of golden fabric, so as to have plenty of light to see the progress of the developement of image and that there is plenty of bench room to hold the various baths, dishes, bottles &c.

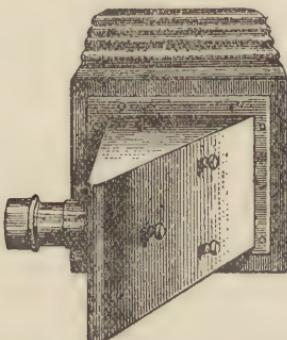
The camera must be of the copying type with a long bellows and should not be less than 12 by 10, fitted with rackwork so as to be able to get absolute sharpness in focussing.

It will be a great advantage and aid in adjusting the position of the drawings to be copied on the focussing screen, if a line be drawn in the centre vertically and another horizontally so that they bisect each other exactly in centre, then *from the centre* mark and number each inch and $\frac{1}{2}$ inch upon each of the four arms of the cross, it can then be seen at a glance not only that the picture is in the centre but also that it is about the right size.

The dark slide must be light-tight, and made for strength and not for portability.

The lens should be of the rectilinear type and should be capable of covering the largest size plate the camera will take, quite sharp to the corners ; for a 12 by 10 plate a lens with an equivalent focus of about 18 inches will be best.

To the lens should be fitted a reversing mirror of silvered glass mounted behind the lens by preference, as such a style of mounting not only protects the surface of mirror from the air but keeps extraneous light from detracting from the brilliancy of the image.



The camera must be mounted upon a solid table stand fixed upon small grooved or flanged wheels, such wheels running either upon rails fixed upon or in grooves cut into the floor at right angles to the wall against which the copying board is fitted.

The copying easel is placed perpendicularly in front of and perfectly parallel with the camera (a mirror being used the camera is sideways to object, not facing it, as in copying direct).

The easel should be so contrived that it can be raised or lowered and moved right and left, which double motion is managed by having the easel double, the up and down motion being obtained by hanging the back portion like a window sash, the weights being exactly the weight of the whole easel and the pulleys over which the cords go not running too freely.

At the top and bottom of back portions of easel are projecting strips with a rabbet deep enough to allow the front or copying board to slide sideways but not loosely ; this front board should be painted a dead black with white lines in centre from top to bottom and from side to side, these white lines being divided into inches and half inches from the centre so that the drawing may be pinned in the exact centre without trouble.

A convenient size for a copying easel will be 5 feet high by 4 feet wide.

In connexion with the camera the only thing left to describe is the focussing cloth which should be quite opaque and of ample size to exclude all extraneous light from behind when focussing.

For focussing the image absolutely sharp a magnifying glass will be required and which may be purchased at any Opticians or Photographic dealers.

Section II.—Wet Collodion Process.

THE COLLODION.

Methylated Spirits of Wine (pure) 30 ounces.

Methylated Ether .720 40 ounces.

Schering's Cellodine 1½ cakes.

Cut the cellodine into thin strips, or, if it be hard, break it up in a clean mortar, and dissolve in the above mixture of Alcohol and Ether, when dissolved that forms the collodion.

The IODISER is composed of

Bromide of Zinc 150 grains.

Iodide of Zinc 350 grains.

Methylated Spirits of Wine ... 10 ounces.

When the salts are dissolved, filter and add to the collodion.

The filtering is best done by placing a peldorf of cotton wool in the neck of a glass funnel and passing the iodiser through it and to prevent evaporation, lay a glass plate over the funnel.

The iodiser being added to the collodion shake up thoroughly and allow to stand for a week to settle, then decant into convenient sized bottles for using ; this collodion is ready for use in a week, and will improve with age up to 6 months, after which time it should be mixed with new.

Most photographic manuals say that collodion made with methylated solvents will quickly contaminate the bath and eventually prevent the formation of a properly sensitive film, but that, in my experience, is a total fallacy, and I have used some

gallons of collodion of my own make and of commercial, made presumably with absolute solvents ; let the student procure pure sweet-smelling methylated spirits from a respectable chemist and go ahead.

When coating plates with collodion it is not a wise plan to pour the surplus from the plate back into the bottle from which it was poured, but to pour it into another, kept handy for the purpose, the contents of which are, at the end of the day's work emptied into the stock bottle after such a quantity as is sufficient for next day's consumption has been decanted into the pourer.

The best bottle from which to pour the collodion upon the plate is the tall capped bottles sold by the dealers as collodion pourers.

The Silver Bath is a most important factor in the production of good negatives and must be compounded with care and used with skill.

To make it, dissolve 6 ounces of nitrate of silver in 10 ounces of water, then add 10 drops of collodion, and shake up well, then add 70 ounces of water, and let it stand all night ; then filter through a pledget of cotton wool packed loosely into the neck of a glass funnel into a clean bottle or jug, such bottle or jug being kept solely for use with the silver bath, as also the glass funnel, then add 1 dram of nitric acid and let it stand all night before trying.

The bath holder may be an upright vessel of the ordinary pattern, with a dipper with which to lower the plate into the solution, or it may be a flat dish with a cover to keep out light and dust, and using a silver hook to lift the plate from the solution if the former shape be chosen, let the dipper be of glass, porcelain, silver wire, or of wood soaked in melted parafin, but on no account of ebonite as such a dipper will cause spots and derange the bath sooner or later.

If a flat dish be used the best form is that introduced by Mr. H. J. Burton, principal operator of the Autotype Company, which is a wooden dish lined with asphaltum hanging on a cradle, the lower end being a well to hold the solution, in this form of bath the plate after sensitising is drained thoroughly before taking

it out which is a great convenience as not only is silver solution saved but the dark slide will last much longer.

The Bath solution made up as above will be the right strength for work, but as every plate sensitised therein takes away its modicum of silver, after a certain time it must be strengthened as it is essential for the production of good work that the solution be kept at a proper strength. The best way of doing this is to add a dram or two of a saturated solution of nitrate of silver, after each day's work has been done, and if the solution be worked in a flat bath, it will be as well to pour it into the jug and filter it before using again ; with an upright holder, this filtering will only require to be done about once or twice a week, as any particles of dust, &c., subside and have not the same chance of falling upon the film as in a flat bath, but the addition of the silver solution should be made, and the solution well stirred up with the dipper.

In course of time a silver bath will get contaminated with organic matter from various causes and will also get supersaturated with ether and alcohol and also with Iodo, Bromo, nitrate of zinc, and will either refuse to work or only yield imperfect films and thin images, in which case the best plan will be to take 20 ounces of the solution, dilute it with clean water 60 ounces, filter, and add 6 ounces of nitrate of silver and again filter when a new bath will be the result.

The silver in the rejected portion of the old bath should be precipitated as a chloride by the addition of a solution of common salt, the precipitate dried and sent to the refiner, together with the ashes of the filtering papers, blotting paper used to drain the plates upon, or to wipe the backs of the plates, after leaving the bath and before putting into dark slide.

The Developing Solution.

First of all purchase 7 lbs. of commercial sulphate of iron (copperas) and put this into a gallon jug and fill up with boiling water (clean) stir up with a clean rod at short intervals for 3 or 4 hours, then allow to stand until the sediment settles and the top portion of solution is clear and bright, then decant as much as

possible into a bottle or bottles and label saturated solution of iron, then again fill up the jar with boiling water, stir until as much is dissolved as possible so as to be ready by the time the stock in the bottle is exhausted, repeating the process until all the crystals are dissolved, then wash out the jar, rejecting the residue and begin again.

But bear in mind that unless there are crystals left in the solution after each addition of hot water, it will not be saturated, therefore before taking the solution into use, be sure there are undissolved crystals in the jar.

For use, take of—

Saturated Solution of Iron	...	10	ounces.
Acetic Acid	...	...	4 ounces.
Water	...	...	70 ounces.
Methylated Spirits of Wine—1 ounce to 5 as required.			

In the above solution the alcohol is added to enable the developer to readily assimilate with the sensitive film, and the quantity requisite varies with the age of silver bath, or to be more correct, with the quantity of plates sensitised therein. At first little or no alcohol will be required, but after a number of plates have been sensitised, then the developer refuses to flow evenly and seems as though it wants to run over the edges of the plate, this is a sign that more alcohol is required, and when more has been added the developer will flow evenly as before, but when 80 ounces of developer require over 4 ounces alcohol to make it flow, it is a pretty sure sign that the bath wants re-making.

The developer is applied to the plate after exposure from a straight lipped cup or glass measure which should be kept for the exclusive use of this solution, as the mixture of any of the other solutions with it will at once counteract its working power.

The Fixing or Clearing Solution is made of—

Cyanide of Potassium	...	...	3	ounces.
Water	...	...	20	ounces.

This solution is highly poisonous both in solution and vapour, so ought to be kept in an upright holder, the plate being lowered into the solution on a dipper, keep the solution well covered up so as to prevent evaporation as much as possible.

After being in use a little time this solution will get weak and should be strengthened by the addition in the evening of a lump or two of Cyanide and then stirred up with the dipper in the morning, the negative must not be left in this solution too long or the density of the film will be impaired, but must be removed and well washed directly all the yellow iodide has been dissolved.

THE INTENSIFIER, No. 1

Water	...	...	...	80	ounces.
Chloride of Ammonium	2	ounces.

dissolve then add—

Bichloride of Mercury	2	ounces.
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dissolve, and filter.

No. 2

Liquor Ammonia '880	5	ounces.
Water	20	ounces.

Solution No. 1 is best kept in an upright holder, as if kept in a flat dish there is always the danger of cutting the skin with the glass plate and getting the mercurial poison into the system.

No. 2 is kept in a well stoppered bottle and only sufficient for each plate withdrawn when required.

Another method of intensifying for those who object to the use of mercury is to bleach the negative in a solution of—

Ferrid Cyanide of Potassium	...	...	6	parts
<i>Red Prussiate of Potash</i>	...	...	4	parts
Nitrate of Lead	...	...	...	80 parts
Water	...	...	...	80 parts

dissolve and filter—

When the plate is bleached wash thoroughly under the tap taking care that the edges and corners of the film are washed as well as the centre, then flood with a sufficient quantity of—

Nitric Acid	...	...	...	1	ounce
Water	...	...	...	80	ounces

allow this to remain on a few seconds, then wash and flood with sufficient quantity of—

Sulphide of Ammonium	...	...	1	Part
Water	...	...	...	5 Parts

which will at once turn the film an intense black, again wash and

flood with the Nitric Acid solution and again wash ; then the negative is put away to dry.

This method of intensifying is cheaper than the other and if the washes of acid between and after the other two solutions are carefully done, and the stench of the sulphide not objected to, then there is little or no difference in the results, but if the acid washes are omitted or (and) the sulphide has not been kept corked, and is consequently not fresh, then there is a great danger of a brown stain upon the lines which is more or less fatal to getting a good print on zinc.

The glass used as a support for the collodion film, should be thin flatted crown of the best quality, as the negatives as a rule, are not required again after once the zinc is etched, so that the film is washed off, and the glass used again, which cannot be done so often if the glass is of bad quality, flatness is a *sine qua non* as it has to be subjected to heavy pressure between a zinc plate, and the front glass of printing frame.

When new the glass merely requires polishing with a clean wash leather kept for this purpose only.

The best way of doing this is to cover a flat board 24 by 18, or thereabouts, with a good American cloth glazed side out, a plate laid upon this will not slip about when being polished.

Both sides and edges of the plate must be well cleaned, as one of the most prolific causes of derangement of the silver bath is from organic matter introduced therein by imperfectly cleaned glass plates.

One side of the plate if gently rubbed with the thumb nail will be found smoother than the other, this being the most suitable side for the support of the collodion film ; this side is polished with the leather until, upon breathing gently upon it, the film of moisture is quite free from marks or streaks, not only in the centre but at the sides and corners.

It is absolutely necessary that the plate be chemically clean all over, else the film of collodion upon drying will split and the negatives be spoilt.

When the plate is clean an edging of india-rubber dissolved in benzole, about an eighth of an inch wide, is run all round the

edge by means of a small camels hair brush, tied to a stick, the end of stick being level with point of brush, the stick acting as a guard against the brush going too far from the edge.

Glass plates that have been used and not varnished are freed from the films by being immersed in mixture of Hydrochloric or Nitric acid and Water for a few hours, then washed under the tap, and well rubbed with a rag and allowed to dry, when they are polished same as above.

Negatives that have been varnished are cleaned by first immersing in a hot solution of common washing soda until the film comes off, then wash under the tap rubbing well with a rag, then immerse in the acid solution so as to neutralize the alkali ; again washed and dried.

The films that are removed from the glass plates, must not be thrown away, but should be carefully collected, dried and sent to the refiner with the other silver waste, a good plan of saving these films, and at the same time keep the acid and soda solutions clear of them, is to filter each solution occasionally through an old felt hat suspended conveniently over the tanks using one for each of the tanks.

The polishing of the glass plates, must not be done in the dark room, or the crop of comets, spots &c., upon the negatives will be exasperating in the extreme, let this operation be conducted in an extreme corner of the studio, where no other operation will disturb this, and where the fluff from the dusters and leathers will not interfere with any thing else.

CHAPTER II. PHOTOGRAPHIC MANIPULATIONS.

THE chemicals being prepared and in their places in the dark, polish a glass plate, run the edgeing of india-rubber along the sides and allow it to dry, then dust the plate with a flat camel or badger hair brush kept for this purpose only, now attach back to a pneumatic holder and holding the plate face up in a horizontal position, with the left hand, pour upon towards the right hand corner furtherest from the body, a little more collodion than it is judged will be sufficient to cover the plate, let the collodion run to the corner, then incline the slate to the left and the collodion will run into the upper left hand corner, now by inclining towards the body the collodion will flow into the lower left hand corner, and from thence it is guided into the funnel placed in the bottle prepared for its reception ; during the time that this surplus is draining the plate must be gently rocked sideways so that the lines formed by the collodion in draining are merged into each other leaving the film quite homogeneous, as soon as the collodion ceases to drip, release it from the pneumatic holder and touch the lower ridge of collodion and when firm raise the dipper from the bath and place the plate upon the projecting lip collodion film away, then lower steadily and gently into the solution and when the dipper touches the bottom raise it a quarter of an inch and move the plate gently sideways and up and down (but do not let top of plate leave the solution) for about 30 seconds so as to prevent streaks in the direction of the dip, in lowering the plate be careful that there is no halt in the operation or else there will be a mark across the film which will spoil it.

The plate will require an immersion of about 3 minutes for proper sensitising and this interval, the Bath being covered up to prevent the access of white light—may be utilized to give the final

adjustment to the camera and to see that the drawing or print to be copied is properly in focus.

Use a medium Diaphragm in the lens for focussing and examine the image all over before deciding that it is sharp, focus by preference about half-way between centre of picture and the edges, and when after moving rack to and fro until the proper sharpness is obtained, take out the Diaphragm and substitute the smallest sent out with the lens, or if the picture to be taken be small and from a large original, then the second or third smallest may be used.

Now remove the focussing screen from the Camera (note that the ground round side of glass has been next the lens) and place the cap upon the lens close the door of the dark room, open the dark slide, see that the proper carrier is in it, then raise the plate from the bath slowly and if the film is free from greasy marks the plate is ready, but if the solution does not flow from the plate evenly move up and down, in and out until it does, then release the plate from dipper, and holding it by the fingers of the left hand with a corner resting on edge of bath, lower the dipper back into the solution with the right.

Now with both hands holding the plate in such a manner as to avoid touching the film, allow the solution to drain from the plate as much as possible, then lean the plate against the wall, the lower end resting upon a pad of clean blotting paper so as to catch any further draining; now with a pad of blotting paper or papier-joseph wipe the back of plate as dry as possible, which will prevent stains and keep the dark slide from rotting by the action of the silver solution.

The plate being drained, lay a piece of thin filtering paper in each lower corner of carrier so that the plate will rest upon the filtering paper which will catch any further drainings from the film and be a safeguard against stains.

Now lay the plate face down in the carrier of dark slide, close the door and fasten it.

The dark slide is now carried to the Camera and inserted in the grooves previously occupied by the focussing screen, taking notice that the sliding shutter is next the inside of camera, and

when pushed quite home cover the back with focussing cloth and pull out the shutter when the plate is ready for the exposure.

The time of exposure will vary very much with the time of the year and with the amount of light falling upon the object being photographed, the exact time can only be found out by actual practise, but the operator in time by observation will be able to guess it pretty correctly.

In taking the cap off the lens be sure that the camera is not shaken else the picture will be spoilt.

The exposure being made, close the sliding shutter, remove the slide to the dark room and close the door, lay the dark slide (with sliding shutter down) upon the bench, open the back shutter, and placing pneumatic holder in centre of plate, lift it out of the carrier.

Take the plate to the sink and holding it face up in the left hand, take the developing cup in the right and with a quick motion pour over the plate sufficient developer to cover the whole film, the developer must go all over the film in one even wave, any hesitation in this will result in a stain, pour upon the film only sufficient to cover it and be careful to spill as little as possible into the sink or else the image will be thin on account of the absence of the free silver washed off by the wave of developer.

Now rock the plate gently so as to keep the developer flowing to and fro over the film, (but keep it there, don't spill it off) and the image will soon appear faint at first, but growing gradually darker, the black lines of drawing being white and the white paper black, and if the development be continued too long the lines will eventually be veiled, therefore as soon as the finest details are out and well defined, place the plate under the tap and allow the water to well sluice the film all over ; as soon as properly washed which can be seen by the water flowing evenly over without greasy looking lines, hold the negative up in front of window and examine for spots or stains, as if there be any present that at all interfere with the picture, at once reject the negative placing it in a pan filled with water to be washed off at leisure and start afresh.

The negative being satisfactory give it another rinse under the tap and place in the Cyanide Bath, where the unaltered iodine will speedily be dissolved, then it is withdrawn and well washed under the tap and whilst the water is washing over the front rub the back with the fingers or a sponge and then turn the plate over and allow the water to wash the back also, it is now ready for immersion in intensifier No. 1, where it remains until the film is bleached almost white, when it is thoroughly washed drained and flooded with a small quantity of Intensifier No. 2, which will at once turn the film to an intense black, or if the action does not penetrate through to back of film continue the application until it does, again wash, then place negative on a rack to dry.

When dry the negative should be varnished with a Benzole varnish, sold by the dealers under the name of positive or Ferro-type varnish. Negative varnish may be used but unless very thin it is apt to be sticky and render the negative easily marked by the heavy pressure it is subjected to in the printing frame.

Now lay the varnished negative face down upon a piece of clean white paper, when, if it is a good one, all the details of the original will show through clear and distinct, but if any of the details are missing or veiled over, the negative will not do, and another must be made.

This process does not always work satisfactorily, but with care and cleanliness no serious fault should arise.

Sometimes the Bath may give what are called foggy images, which is indicated by a veil over the lines which often can be wiped off with a pledge of cotton wool, in which case the addition of $\frac{1}{2}$ a dram of nitric acid to the 80 ounces of solution, thoroughly mixing this up and a rest for a few hours will end this difficulty. If the dark room window be not of the proper colour fog also will ensue, therefore the non-photographic experimentalist had better call in the aid of a professional Photographer in case of any difficulty in getting clear negatives.

Jabez Hughes' shilling *Practice and Principles of Photography*, published by Mr. Werge, of Berner's Street, Oxford Street, will be a profitable investment, getting if possible one of the earlier

editions published before the advent of Dry Plate Photography when the wet process reigned supreme.

A suitable negative being obtained the next process is to print from it upon a zinc plate which, will be treated of in the chapter following the next, which will be devoted to a description of the apparatus and materials required.



CHAPTER III.

APPARATUS & MANIPULATIONS IN ZINC PRINTING.

Section I.—Polished Zinc Plates.

ZINC Plates suitable for Photo-engraving can be obtained either in large sheets or cut to size as ordered, and when new, merely require polishing with a damp rag dipped in levigated pumice powder, *i.e.* the pumice powder washed in water so as to get rid of any grit that may accidentally have fallen in.

Lay the plate upon the polishing board covered with American cloth and polish with, a from and to the body motion, not circular do not use a great deal of pressure the object being to get the plate highly polished with a perfectly smooth surface.

Plates that have been printed upon and are not satisfactory are cleaned off and re-polished in the same manner.

Plates that have got scratched will require polishing with emery cloth to remove the scratches which would otherwise interfere with the picture.

To remove these scratches sprinkle face of plate with turpentine, then rub with a piece of FF emery cloth (this is Oakey's brand, other makers brand theirs' of the same degree in other ways) stretched over a carpenter's cork covered rubber, use the same motion, to and fro until all the turpentine has evaporated and the surface of the zinc polished, and if the scratches are removed the plate is ready for use, but if not then, the operation must be repeated. If the scratches are too deep for the FF cloth begin with a coarser and finish with the fine.

Section II.—Graining the plate.

The next operation is to give the plate a slight tooth so that the sensitive solution will flow evenly over the surface.

This graining is done in a wooden tray, 24 inches by 18 by 6, lined with asphaltum or gutta percha and mounted upon rockers, it is quite necessary that the graining tray be of a large size, as if only a little larger than the plate, the returning wave of acid water will mark the edges of the zinc.

~~4 oz~~

~~8 drops~~

Into this tray pour a quart of clean water, and add 1 dram of nitric acid and 1 ounce of a saturated solution of common alum, place the face up on the bottom of tray, and commence rocking at once or else the acid will mark the surface and it will require re-polishing ; rock slowly for five minutes during which time the polished surface will give way to a fine matt like fine frosted silver, now remove the plate and rinse under the tap rubbing gently with a fine sponge or a pledge of cotton wool to remove the scum or deposit formed by the acid. The surface at this stage should be quite smooth, if it is at all rough the acid is too strong and the solution must be diluted with water, if the action of the acid is very slow, then a little more acid must be added but it will only be necessary to add more alum when the plate is a bluish colour instead of being a pearly grey.

A drop or two of acid will be required each time a plate or batch of plates are to be grained.

In rubbing with sponge or pledge of cotton wool when under the tap, care must be taken not to scratch the surface of zinc or else it will need re-polishing.

(COATING PLATE WITH SENSITIVE ALBUMEN.) *formula*
 p. 27

Section III.

If the solution of albumen was poured over the plate and drained and dried, the solution would be too thick at the bottom and too thin at the top, it is therefore necessary to ensure an even film of sensitive albumen, to subject the plate to a quick circular motion so as to spread the film of albumen evenly, and to get rid

of the surplus solution not required, this is effected by placing the grained zinc in the jaws of an instrument called a whirler made as follows:—

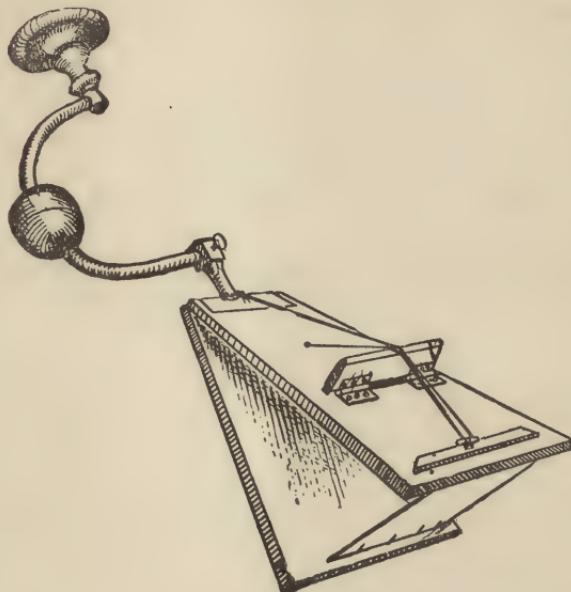


FIGURE 2.

Two pieces of wood each half an inch thick, twelve inches long, nine inches wide at one end, and six inches at the other, upon the narrow end of one piece fix with four screws, a piece of iron the shape of a \perp the top end of which is shaped to fit into the socket of a common carpenter's brace (which must have the centre handle revolving, not fixed like some of them are) the cross piece being flat and pierced with four holes countersunk to admit of stout screws to go through.

This being done place the two pieces of wood together, the \perp piece between the two, and with a piece of stout leather hinge the two together, nailing the leather not only on the outside but upon the top also, now screw a narrow batten on each of the pieces about an inch from the widest end to keep the wood from warping.

Four inches from top (the hinge being the top) bore a hole right through both pieces and pass through a couple of strong leather laces, fix one end of these on the outside of the cheek to which the iron \perp is screwed, and on the outside of the other cheek seven inches from top, hinge a piece of wood (so as to fall towards bottom) 5 inches by 2 by $\frac{1}{2}$; and in centre of the batten screwed on to prevent warping, fix a broad headed nail or a turn button, over which the free end of the leather laces can be passed.

Now about half an inch from each end drive, in a straight line right through the wood 6 or 8 wire nails one inch long so that the points project on the inside of each cheek, now fix the top of iron into socket of brace and the thing is ready for use.

To use this instrument, lay it upon the bench, raise the upper jaw, place the grained zinc behind the teeth (face out) close the jaw and after seeing that the face of zinc is close up to the teeth, tighten the shoe lace, pass it over the hinged piece (which is lying down close to the cheek) and round the screw on batten with two or three turns, then pass it back and tie the loose ends round the iron shank at top, then raise the hinged piece which by straining on the leather laces will cause the jaws to grip the zinc tight and hold it in position, see figure 2.

Now lift up the whirler from the bench, grasping the handle of brace firmly in the right hand, hold it at arm's length, and by a series of quick jerks set the plate revolving which will require a little patience to do evenly and rapidly, but with a little practise it will be quite easy.

The plate is coated twice, whirling it after each application of the sensitive mixture, then the whirler is laid upon the bench the hinge piece let down, which relaxing the strain upon the leather laces, will allow the jaw to be lifted and the plate removed.

The film of albumen now requires drying, which should be done over a spirit lamp, the best form of which is one of the small pocket spirit stoves sold at the ironmongers at 1s. and 1s. 6d., and then having the three supports for a kettle cut away. The zinc is held over the flame and kept in constant motion, so as to dry the film as quickly and evenly as possible, no fear

need be felt at applying too great a heat so long as the metal can be held comfortably in the fingers, and when dry the plate is ready for printing upon.

(It must be borne in mind that the film on the zinc is now very sensitive to light, therefore the preparation of the film must be done in a yellow light, as must also the operation of placing in the printing frame, inking up, and development, gas or lamp light may be used, as the film is not sensitive to artifical light of a low actinic power.

THE PRINTING FRAME.

Section IV.

The printing frames used for this process must be the box pattern, fitted with stout plate glass fronts, the cross bars behind being fitted with wooden screws instead of springs, as absolute contact can only be obtained between the surfaces of the glass negative and the zinc plate by means of screw pressure.

The front glass of printing frame must be kept perfectly clean, and especial care must be taken that no grit be upon either glass, inside frame, or on back of negative, else the negative will be sure to smash.

TIMING THE EXPOSURE.

Section V.

The time of exposure to light is measured by means of an actinometer, which is simply an instrument in which is a strip of sensitive paper, either under a gradated series of different thicknesses of translucent paper, each division of gradations being distinguished by a number thus: No. 1 has only one thickness of paper over it, No. 2, two thicknesses and so on, but on account of the ever varying intensity of the light, a screen actinometer that is reliable is almost an impossibility, therefore

the best form of actinometer is Johnson's single tint (sold by the Autotype Co. at 2/6 each) its only drawback being that it must be closely watched in a bright light, so that the tints are changed evenly.

This actinometer is very simple and handy ; it consists of a cubical box with two lids, the inner one serving to press the paper in contact with the glass of outer lid, the outer lid has a circular opening with a narrow rectangular strip in centre transparent, the rest of glass being covered with pigment the colour assumed by the sensitive paper after exposure to the light, and when the strip of sensitive paper inside has assumed this colour, it is called one tint, the strip of paper is then pulled forward, and another portion quite white is brought under the transparent portion of glass, and when the light has turned that the colour of the pigment, that counts two tints, and so on.

The exposure of zinc in the printing frame under a good line negative, will be about three or four tints in diffused light, or about two or three in sunlight.

Section VI.—Inking the Exposed Zinc.

The sensitive zinc being exposed to light under the negative, the next operation is to cover the surface with a thin coating of Winstone's transfer ink.

For this purpose we require a type printer's composition roller, mounted upon a litho stock. This roller must be perfectly smooth, cast in a solid mould, as the line along the side formed by a split mould would render it useless for inking up a zinc plate, a useful sized roller will be eight inches long by five or six in diameter. We also require an inking slab, a palette knife, a bottle of turpentine with the cork cut so that the turpentine can be sprinkled out without having to remove the cork, a tin of
 ~~x~~ Winstone's photo. transfer ink, and a linen cloth or two.

The inking slab may be of smooth iron or a suitable sized lithographic stone.

The palette knife should be strong and flexible.

~~x~~ formalin ?

? (wax)

oil
lampblack
soap

CHAPTER IV.

PRINTING ON THE ZINC.

THE negative being ready for printing, (Chapter II.) select a piece of zinc a little larger each way than the picture, polish as directed in Section I. Chapter III., then grained, Section II., and after well washing under the tap and gently rubbed with fine sponge or plegget of cotton wool is placed in whirler, Section III., and again rinsed under the tap, (now invert the whirler and set it revolving, then examine the surface of zinc and see that there is no dirt on the surface, but that it is quite smooth, if not, rinse under the tap and rub gently with the sponge, and again rinse, which should quite free the zinc from any deposit of dirt,) now whirl so as to get rid of as much as possible of the water, then pour over the surface of zinc as much as will cover it of the following solution, carefully filtered through cotton wool.

{ Albumen of one egg	...	...	...	...	...	...
Water	...	...	...	...	...	7 ounces.
Saturated solution of Bichromate of potash	...	...	...	...	...	1 ounce.

Place the white of egg into a bottle containing a lot of small pieces of perfectly clean glass, then add the water and shake well up for a minuite, then add the solution of Bichromate, again shake well and add two drops of liquor Ammonia. Now place a plegget of cotton wool into the neck of a glass funnel and pass a few ounces of clean water through (if this is not done there will be a difficulty in getting the albumen to filter) drain as much as possible of the water away and then filter the albumen into a clean bottle, when all the solution has gone through, remove the cotton wool from the funnel, which well wash, then re-charge with a fresh plegget, pass some water through and (again filter the albumen solution through into this time a ten ounce glass measure which is to be used for pouring out of upon the zinc,) the stem of the funnel should be long enough to reach the bottom of glass measure so that the formation of air bubbles be avoided, which is

impossible with albumen if the funnel is not below the surface of the filtrate.

With this, pour over the zinc sufficient to well cover the surface, letting any surplus go into the sink, then set the whirler revolving, coat again, and again whirl, now examine the surface and if free from dust, spots and air bubbles, remove the zinc and dry it over the spirit stove, Section III. but if either air bubbles or dust be present, wash off under the tap and begin again.

The film being dry get the printing frame ready, see that the surface of glass inside is quite clean and free from grit, as also the back of negative, taking special care that the ridge of varnish which often forms at bottom of negative be removed, as the slightest inequality of surface will surely cause disaster directly the screws exert their pressure.

Do not lay the negative into the frame flat upon the glass, but slide it in from one side so as to carry any dust away from the glass front of printing frame.

The negative being in the frame film side up, place the coated zinc upon it face down, judging the proper position and placing zinc flat down upon negative, now put a piece of brown paper over back of zinc, then place the back of printing frame in its place, fasten down the cross bars and apply the pressure screws evenly and gently.

Do not screw one side tight before the other has been touched but screw down so as to tighten all as near level as is possible.

Even pressure being applied, see that the front of frame is clean, and then expose to light simultaneously with the actinometer Section V. Chapter II., and when four tints have been registered remove the frame to the dark room, unfasten the cross bars and remove the zinc, taking great care to lift the zinc without scratching the film against film of negative.

Now after wiping the inking slab with a clean linen duster, place a piece of the photo. transfer ink about the size of a small bean upon the upper corner, sprinkle this with a little turpentine and mix with the palette knife until about the consistency of printing ink.

Now spread some of this mixture as far over the inking slab with the palette knife as possible, and then distribute it with the roller, Section VI., Chapter II., rolling to and fro, across and diagonally until there is a thin even coating of ink all over the slab (not touching the corner where the ink was mixed with the turpentine) and upon the roller ; if the mixture is too dry and refuses to spread, sprinkle a little more turpentine but do not use too much else it will take a long time to evaporate.

The roller having an even coat of rather moist ink spread evenly upon it, place the exposed zinc face up on a piece of clean white paper and proceed to roll briskly to and fro using a moderate amount of pressure, until the whole of the turpentine has evaporated leaving a thin coat of ink with an even matt surface, not thick enough to quite hide the yellow film of the sensitive albumen, as if it does too much has been put on and it will most likely smear in developement.

If after first applying the roller the ink on the zinc seems likely to be too thick, at once wipe the roller dry and then roll the zinc briskly until the coat of ink is perfectly even and the turpentine evaporated.

At this stage every thing depends upon getting the coat of ink even, if there are patches of thick and patches of thin, the zinc is spoilt and must be done over again from the beginning, *i.e.* polish it, grain it, coat and print.

An even coat of ink being obtained, the zinc is laid in a tray containing clean cold water of a sufficient depth to well cover the surface, now take a plegdet of cotton wool and rub the surface gently, when the ink covering the albumen protected from light by the black portions of the negatives will wash away, leaving the picture on the zinc in ink ; if the finer details do not develope easily, continue the rubbing with the cotton wool but be careful not to rub so hard as to scratch the ink lines.

All details being developed rinse under the tap and put away to dry which at ordinary temperature will only be a few minutes.

The chances of failure in this portion of the process are first of all air bubbles and dust spots in film, which will at once declare

themselves and for which the remedy is increased care and cleanliness.

If upon development some of the lines are missing, then the zinc and the negative have not been in absolute contact, or if the finer lines wash away easily, then the exposure has not been long enough, whilst if it has been too long, either the finer details are covered up or the whole refuses to part with any ink, then the zinc has been exposed too long.

Zincs that have been printed upon and are failures are re-polished as directed in Section I., Chapter II.

A satisfactory print on the zinc showing all the lines in the original drawing, is then dried when it is ready for etching in relief.



CHAPTER V.

ETCHING IN LINE.

THE first stage in this part of the process is to warm the zinc slightly upon the hot-plate, which is a flat iron plate about 15 by 12, with an under flange underneath about 3 inches deep, perforated about half an inch from the under side of plate, with quarter inch holes one inch apart, a gas pipe bent in a circle and perforated with small holes about half an inch apart, is placed about half an inch below the bottom of plate, and when the gas is allowed to flow into this pipe and a light is applied, there is a flame at each of the small holes, the heat from which will warm the plate.

Do not make the zinc hotter than the hand can well bear, then remove from hot plate and allow to cool, and with a fine sponge smear all over with a carefully strained solution (in water) of fine picked gum the thickness of cream, and allow it to dry spontaneously, but on no account use heat or the chances are that the gum will crack and take with it all or most of the image on the zinc.

The gum being dry, rinse under the tap and rub gently with a fine clean sponge, and lay face up on a piece of clean smooth paper, proceed to roll up with an india rubber roller (mounted on a litho. stock) charged with an even coating of litho. printing ink thinned with middle tint varnish as stiff as ever it can be worked, previously wetting the zinc with as much water as it will hold.

Now a moderate pressure and a quick motion, recharging the roller from the inking slab at short intervals and using plenty of water to prevent the whites taking up ink, which if they do squeeze water from a sponge and rolling up with the roller denuded of ink, using a quick motion, will, unless it is a bad case soon pick up the ink from the parts not requiring it.

The rolling is continued until the image is an intense black much stronger than it was at first, in which condition it is ready for the first etching bath, but previously the back of zinc and

edges and also those portions of front outside the picture must be coated with a bitumen varnish, so as to prevent the acid eating away those portions and undermining the image.

If any of the lines are defective, or any touching up is required, also if a line or border is to be ruled round it, that must now be done.

Then slightly warm the plate so as to melt the ink slightly, when it will sink into the albumen image and to protect it from the acid. The etching tray is the same shape and size of the graining tray lined with gutta percha or asphaltum and mounted upon rockers.

Into this put a quart of water and add nitric acid a little at a time (rocking the tray so as to thoroughly mix the acid and water) until the acid is just perceptible to the taste, now place the zinc in face up (of course more than one may be done at a time but for the sake of brevity it is presumed that one only is in hand at first) and at once commence rocking the tray and continue doing so for one minute, when the plate is removed and rinsed at once under the tap, and the surface gently rubbed with a fine sponge to clean off the deposit of zinc dissolved by the acid.

Now dry the zinc on hot plate, but do not allow it to get heated, then smear with the gum solution (page 31) and with a piece of stiff paper or cardboard fan until gum is dry again, wash under tap gently rubbing with sponge, then lay zinc upon a piece of clean smooth paper, charge the india rubber roller again with the litho ink thinned with middle tint varnish, still using the ink as stiff as it is possible to work it and keeping surface of zinc wet.

The rolling is continued until all the image has received a fresh modicum of ink and is quite even and black all over, if through any mischance part of the whites take ink, cover with water and run the roller very rapidly using light pressure, which will have the effect of cleaning the ink away, but if the gum is well put on, properly dried and not removed in the washing and plenty of water used during the use of roller this dirtying of the whites will not take place.

The second rolling up being completed, the zinc is laid upon hot plate, and allowed to remain there until the ink is slightly melted which will cause it to run down the sides of the lines etched by the first bath, when this is done, allow to cool and it is ready for the second etching bath, which is prepared by adding a few drops of Nitric Acid to the bath already used, to strengthen it to the original strength, and, a little more, but still not stronger than just perceptibly acid to the taste.

This being done the plate is immersed, the tray set rocking for three minutes at the end of which time it is removed from the bath, washed under the tap, gently rubbed with sponge, (taking care not to abrade the lines,) covered with gum, fanned dry, rinsed under tap, and again rolled up, using a leather roller, and ordinary type printing ink, being still careful to keep surface of zinc well covered with water.

When this is done, warm the zinc just sufficiently to dry the water off, which must be done thoroughly but do not subject to a strong heat. The zinc being dry, dust it over carefully with powdered resin (from a sieve with 120 holes to the square inch) cover the whole of the surface, then with a camels hair brush remove all that does not stick to the ink.

Now having dusted all the resin off that will come away under the brush, place the zinc upon the hot plate, and let it remain there until the resin is melted and incorporated with the ink. This will cause the ink to run down the sides of lines formed by the second etching and protect them from being undercut by the acid in the third etch.

Let the zinc cool, then again immerse in the acid bath, which must be again slightly reinforced with fresh acid and keep the tray rocking for five minutes.

The plate is again washed, dried, gummed, fanned dry, washed, and rolled up, using the same roller and ink as before ; it is then heated so as to melt the ink, allowed to cool and again immersed in etching bath (which has again been reinforced with fresh acid) this time for ten minutes.

This time of rolling up will cover up some of the finer details as they are now etched deep enough, but the middle tints must still remain open for at least one more rolling up.

The duration of the fifth etch will be fifteen minutes, after which the plate is subjected to the same round of operations, but now a roller covered with flannel must be used, and the ink must have a small modicum of fine tallow or palm oil incorporated with it, and after rolling up (using the flannel roller and fresh ink), again dry the zinc thoroughly, and cover with resin powder from the 120 hole sieve, then carefully remove the surplus resin from the plate, and place it upon the hot plate, and allow it to remain there until the resin is thoroughly melted ; then after cooling again subject to the etching bath, which must be again reinforced by the addition of a little Nitric Acid, the time of immersion being longer than the last, as there now ought to be little danger of either stripping the surface ink or undercutting the lines.

The number of times of etching depends entirely upon the depth required in the broadest lights, although if very broad it will not be safe or expedient to etch right through, but only deep enough for the medium lights, leaving the broad ones to be cut out with a fretsaw, or a boring tool fitted to a lathe.

Be sure that the ink is properly melted each time of inking up, so as to spread well on the walls, or sides of the lines, so as to guard against under-cutting.

When it is judged that the etching has proceeded far enough, the resist of ink and resin is removed by the copious use of turpentine applied with a stiff brush, well washed afterwards in clean water and dried.

The plate being cleared from all the ink, &c., if now examined carefully, the side of the lines will show each etching by a series of irregular steps, now if the plate was put into the press in this condition, the chances are that before many copies had been made, these steps would take more or less ink from the rollers, and so blur the image, therefore before passing into the hands of the printer, the plate will require to go through another etching bath or two, so as to get rid of these irregularities.

Charge a leather roller with a moderate amount of stiff typo printing ink, and after slightly warming the engraved plate, proceed to ink up the image carefully, and thoroughly rolling first one way and then the other, so as to get a due modicum of ink upon all parts of the image.

During this operation little or no pressure will be required, as it is only necessary to cover the faces of the lines.

Now warm the zinc upon the hot plate, and then again roll up, and dust over with resin from the 120 hole sieve, and after removing superfluous resin, again place upon the hot plate and melt the resin, so that it incorporates with the ink, and flows down the sides of lines, so as to cover up the first three or four steps, now see that the varnish on back and on edges is intact, or if not, re-varnish or make good, then immerse the zinc in a bath of water 1 quart, Nitric Acid 1 ounce, and keep the tray rocking for five minutes, then remove and wash thoroughly under the tap, rubbing gently with a soft sponge, then dry and remove the ink and resin by means of a stiff brush and turpentine, and again thoroughly wash and dry.

The zinc being quite dry, again ink it carefully, using the leather roller charged with typo printing ink, taking extreme care to thoroughly cover the face of all the lines with ink, turning the plate in every direction, and frequently re-charging the roller upon the slab, then dust carefully with resin, and as carefully remove the superfluous powder with a camel's hair duster, then slightly warm the zinc so as to incorporate the resin with the ink, but do not allow the heat to be sufficient to cause the ink to flow over the sides in the slightest, Now immerse in a bath of water 1 quart, Nitric Acid 2 ounces, and allow it to remain for one minute, keeping the tray in motion all the time, then remove, wash thoroughly and clean off the ink with turpentine and a stiff brush.

The plate is now ready for finishing and mounting ; in the first place the deep whites are cut away with drill or fret saw, or else by the use of a machine called a router, the edges are bevelled so as to afford no ink catching surface, and holes are drilled at convenient places for the insertion of nails to fix the plate to the wooden block, which is to make the zinc plate type high.

To many it may seem strange that some other method of estimating the strength of the acid than by the taste, could be devised, but in practice it is found the best, it is the simplest, and after one or two trials it will be found certain and safe; at no time during the whole process must the acid be so strong as to be unpleasant to the palate.



CHAPTER VI.

PHOTO-ENGRAVING IN HALF-TONE.

WE now come to the most important chapter of this book, viz : the production of Phototype Blocks, or the means whereby the half-tone of a photograph is levelled up, so as to print in a typographic press.

Shortly stated, this is done by interposing a screen, either before the sensitive plate in the dark slide of camera (when copying a photograph direct) or placing the screen behind a transparency on glass when transmitted light is used. In the first instance the image projected upon the sensitive plate having first to pass through the screen is broken up by the dots upon the screen, the result being a definite grained negative. In the second instance, the screen being placed between the light and the negative a similar result follows.

The first method being applicable when blocks are required from good vigorous photographs not overburdened with half-tone, and when the block is for rough printing and not too small.

The second method being more adapted for photographs full of delicate half-tones, and for fine blocks.

For both methods the first requirement will be a proof on fine plate paper, from a plate ruled by machinery with fine diagonal lines as close together as possible.

For commercial work it will be the best to have several plates ruled with varying thickness and closeness of lines, so as to be able to fit a grain to each and every photograph for reproduction, remembering that the more delicate the half tones in the photograph, the finer must be the grain.

The proofs from these ruled plates must be absolutely perfect, not a speck or a spot upon them.

The ruled sheet should be not less than 15 inches by 12 inches, with the lines ruled very close together, and very fine. This being procured, proceed to take from it a series of negatives on wet collodion plates (using very thin glass, perfectly free from defects), varying from 3 inches wide to 10 inches wide, these negatives to be perfectly sharp, the lines being clear glass, and the whites dense.

In Chapter II, Page XVI, will be found full directions for taking these negatives, which are to be treated exactly as if making negatives for zinc printing, but the most extreme care must be taken to ensure perfectly clean films, as the slightest spot of any description will entirely spoil the screen. For these screens it will be best to provide a new Nitrate of Silver bath, and collodion that has been at least a week settling.

The screen negative being made, it must be varnished with a good hard varnish, well filtered and applied in a room quite free from dust.

These negatives take up a good deal of time in making, but as they are the foundation of the process, and with care will last for years, the trouble must not be grudged.

These are the screens for breaking up the half-tones in making a definite grained negative as follows.

For the first method a good vigorous photograph is selected, placed in position on copying board and the camera adjusted so as to get the image on focussing screen the size wanted.

A collodion plate is now prepared, and well drained, then one of the transparent screens is fixed in front of the carrier by drawing pins, by pasting strips of gum paper over, or by fixing with fine tacks a piece of thin card at top, and one at bottom slightly overlapping screen, and holding it firmly in a sort of rebate.

The carrier is now put into the dark slide and the sensitive plate in its place, the door of slide closed and fastened.

The exposure is now made in the camera, and if the screen is properly transparent, the time will not be very much more than when copying in the ordinary way.

The developement of the exposed plate is done by means of the developer given in Chapter 2, and the result must have all the details of the photograph, and the lines of screen must be clear and free from veil.

The negative is washed, fixed in Cyanide, washed again and then intensified, first immersing in the solution No. 1., Chapter 2, until bleached, then thoroughly washed and blackened with No. 2 solution, again washed, dried, and varnished.

For the second method we shall require instead of a paper photograph a transparency on glass.

This transparency may be made on a gelatine dry plate by printing in contact from the negative, or an enlarged transparency may be made, either on a dry plate or by the wet collodion process.

The transparency being made by contact when the original negative is of larger size than the block required, the enlarged transparency being used if the negative be smaller or same size as the block.

The development of these transparencies on gelatine dry plates will be treated of in the appendix, but if wet collodion be used, the manipulations will be the same as for negatives, except that the image is in reverse gradations, the lights being clear glass, and the shadows dense and black. Every detail in lights, shadows, and half-tones must show distinct and strong.

For the production of these enlarged transparencies, an enlarging camera will be required, which may be provided by having an arrangement in front of the ordinary camera, fitted like the figure below, consisting of two boxes, one sliding within

the other, the negative from which the transparency is to be made being placed in a carrier at B.

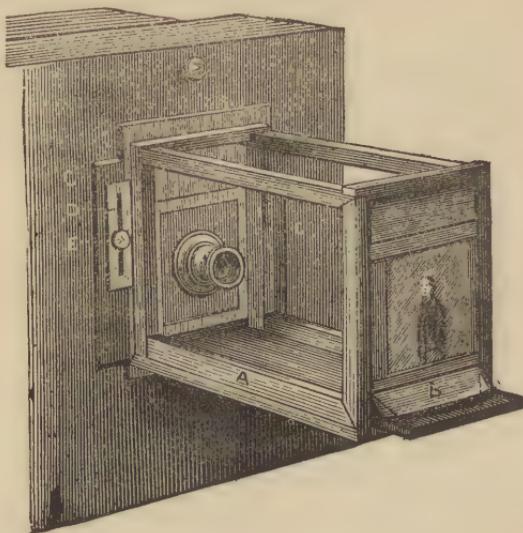


FIGURE 3.

In the illustration the sides are shown open, but only for simplicity, as they must be quite opaque. In using such an arrangement the camera must be brought under the skylight of studio, and the light reflected through the negative by placing a large sheet of white paper at an angle of 45° in front of negative.

Another and perhaps the best method will be to cut a hole in a dark room at a proper height for the camera and fix the negative in the hole, then adjust the focus upon the screen, illuminating the negative by means of a reflector fixed at an angle of 45° outside.

The transparency being secured it is varnished, and any blemishes or spots removed by means of a sable brush and a little carmine colour, it is then placed in contact with a suitable screen, and the two together are put into the place previously occupied by the original negative, now adjust the camera so as to get the image on the focussing screen the proper size, and proceed to make

a grained negative by the wet collodion process exactly as described in Chapter II and above, and when a negative containing all the details of the original negative broken up by the fine grain of the screen is obtained, it may be dried and varnished, and is ready for printing upon the zinc.

Now any pinholes &c., are stopped by means of a fine sable brush and Indian ink, and it is then ready for printing on the zinc, which is done in the same way as described in Chapter 4, but extra care must be taken, first that the zinc plate is thoroughly and evenly polished, second that the graining bath is kept weak with plenty of alum in, so as to have the grain on plate as fine as possible, thirdly, that no speck of dust, dirt, or air bubble be on the film after coating, and that the whirling be effectually done so as to get the sensitive coating as even as is possible.

The inking up requires no comment as it must be done as evenly and thinly as possible for both line and half-tone.

In developement a little more energetic friction will be necessary, but extreme care must be taken not to abrade the ink surface, continue the rubbing until all the details are developed and bear in mind that the finished block will be exactly like the zinc after developement.

In printing these half-tone zincs it often happens (like printing in silver) that to get the best results some portions will require less exposure than others, the best way to stop back any portion or portions is to cover the front glass of printing frame with whiting mixed with water to the consistency of thick cream ; apply with a rag over the places in negative, before exposing to light and at the end of one third, or in case of very deep shades one half the exposure, then clean off the whiting and finish the exposure without any obstruction to light.

The exposure of a grained half-tone negative will be one half to double as long as a simple line negative.

A perfect print on the zinc must contain all the grain intact, as if there is any break in its continuity it is no use proceeding further with it.

CHAPTER VII.

ETCHING IN HALFTONE.

THE zinc plate with image upon it in ink is dried, then warmed slightly on hot plate, cooled and coated with thick gum and fanned dry (not dried by heat or the gum is certain to crack and bring away the image or part of it) then wash under tap, and rub gently with fine sponge so as to remove gum from ink, but not from the zinc, now proceed to roll up as directed in Chapter 5, using the indiarubber roller charged with thick ink and the surface of zinc kept well covered with water, use as little pressure as possible, but let the motion be fairly rapid, and if any portions of image should smear, roll rapidly with slightly increased pressure.

This operation of rolling up the image is the crucial one of the operation as unless it is done properly and when it is finished, the result is a strong black and perfectly even image, it is of no use proceeding further with it, in fact the picture must be perfect.

The rolling up being done any touching up that may be required can now be done, and any fine details clouded over, or made indistinct by the grain, strengthened or opened out, additions being made with transfer ink thinned with turpentine, laid on with a very fine sable brush, whites being put in by scratching through the ink with a fine etching needle.

To rest the hand upon in doing this touching up, so as to avoid touching the image, a bridge is used made of a strip of smooth wood, 1 inch wide, $\frac{1}{4}$ inch thick and sufficiently long to well span the plate, at each end of this strip is nailed narrow strips $\frac{1}{4}$ inch thick which being the feet that the bridge will stand upon will enable the zinc to be slid under it without touching the surface of zinc against the under part of the bridge.

The zinc is now ready for the first etch, conducted in the rocking tray, the Nitric Acid solution being very weak indeed to the

taste, the presence of the acid being scarcely perceptible. The time of immersion in the first bath must not be longer than 30 seconds, when it is removed, washed under the tap, and gently rubbed with sponge, then dry gently on hot plate, allow the metal to cool, coat with gum, fan it dry, rinse under tap and rub with sponge, then again roll up when it is ready for the second etch, which is done in the same bath as the first, without any addition of acid. Keep the tray gently rocking for one minute, then again withdraw, wash under tap rubbing with sponge, coat with gum, fan dry, wash under tap rubbing gently with sponge, and again roll up using the ink on roller a little thicker, but stiff, and then when the image has taken the ink equally, place it on hotplate and allow the zinc to get hot enough to melt the ink slightly then allow it to cool and place in etching bath which has been slightly reinforced with a few drops of Nitric Acid, immersing it this time for 5 minutes.

Then the operations of washing, gumming, rolling up, &c., are to be repeated until it is judged that the etching has been carried far enough, lengthening the time of immersion in the acid solution with each etch, but taking special care to keep the bath weak, do not add acid sufficient to taste readily until near the last etch, and even then it must only just be apparent to the tongue.

The resist is cleaned off with turpentine and a stiff brush, and then a proof is pulled and if further etching will improve it wholly or in part, the plate is inked up and again subjected to the action of the acid bath.

If only portions require re-etching, cover the rest with bitumen varnish, and etch the rest, but it will be scarcely safe to give more than one etch after cleaning off the original resist.

The plate being etched it now requires finishing.

The outside zinc is removed with a circular saw, and then the edges are filed and holes drilled at an angle so that the metal can be fixed upon the block.

CHAPTER VIII.

PRINTING FROM THE BLOCK.

A HALF-TONE block to give results commensurate with the care needed in its preparation must be handled by the machine man with care and consideration.

The blanket on the tympan or cylinder must be replaced with something harder, else the soft pressure of blanket will blur the print.

The block must also be made ready not by putting cut outs on the tympan or cylinder, but underneath the block, and there as thin as possible.

The ink must be good and not too thin, the rollers free from flaws and not too tacky, in fact as much care is required on the press as during the photographic and subsequent operations.



CHAPTER IX.

FOR the successful etching of very fine blocks, it will be best to print them upon the zinc plate in bitumen instead of Bichromated Albumen, as then the first etching can be done without having to ink up, so getting the sharpest possible results but unfortunately bitumen is much less sensitive to light, and the exposure to light under the negative instead of taking minutes, takes hours, although if a good sample of Asphaltum or Bitumen be obtained, the exposure will be much less.

To print in Bitumen, the same class of negative described in Chapter VI, is required.

The sensitive solution of Bitumen is made by procuring a small quantity of Photographic Bitumen or Asphaltum from a good firm, and powdering it in a clear dry mortar. Now take a clean and dry glass beaker, half fill with Methylated Ether, and pour into it the powdered Bitumen, stirring with a glass rod for a few minutes, now cover the beaker with a piece of thin sheet india rubber, and upon that place a piece of thick plate glass so as to make the vessel as air-tight as possible, and allow to stand a few hours, then stir up again, and again allow to stand, this time all night, then pour away the Ether, draining the liquid as closely as possible so as to get rid of all those constituents which are soluable in the Ether. Now add some more fresh Ether, and stir up thoroughly, and again allow to stand and settle, putting on the cover as before so as to prevent evaporation as much as possible. After again settling, the Ether is poured away and all liquid and semi-liquid matter carefully drained away, after which the residue in the beaker is removed to a glass plate and spread out over its surface, so that any Ether remaining may quickly evaporate. During this evaporation of the Ether, the Bitumen must be protected from the action of white light.

When the Ether has evaporated, take of the residue 1 ounce, and dissolve in pure benzole (free from water) 20 ounces, and add a small globule of Venice Turpentine to size of small pea.

When dissolved allow to stand all night, then filter through paper, and it is ready for coating the zinc plate.

New zinc plates will merely require polishing with a fine rag dipped in pumice powder, and a final rub with clean chamois leather, but plates that have been used before must be polished with fine emery ; in either case the action of polishing must be an up and down motion, and not a circular, else the surface of zinc will be scratched, and the slightest scratch is fatal.

The plate being properly polished, the Bitumen solution filtered, lay the whirler on the bench ready for use with the leather lace adjusted to the size of the plate, now with a camel's hair brush dust the surface of zinc, and coat it with Bitumen solution in the same way as coating a glass plate with collodion, but be much more expeditious about it, and directly sufficient solution has flowed over the plate, put it into the whirler (face outwards), and set it spinning at once, this will equalise the coat of Bitumen, and get rid of the superfluous solution ; after spinning a few minutes, put the plate away in a clean dry box. These plates are best kept a short time before used, to get rid of all tackiness, so that they may be prepared in quantity, and stored away in the dark till wanted.

To print upon these plates it will be well to dust them over with fine french chalk, so as to be certain to prevent them sticking to the negative.

The same care in putting into printing frame as enjoined in the chapter on zinc printing with Bichromated Albumen is requisite with these plates, as also is the putting on of pressure by means of the screws.

The exposure to light will vary from one hour in the sun to a day in the shade, but will also vary with the sample of Bitumen, some samples being much more sensitive than others, therefore *experientia docet*.

These prints on zinc are developed by placing the exposed

plate face up in shallow tin tray, and pouring into the tray sufficient turpentine to cover the plate, rock the tray so as to keep the solution in motion, and (if the exposure has been right) the image will gradually make its appearance, the Bitumen protected from the action of light by the dense portions of negative gradually dissolving away as the development approaches completion, great care must be used, and just before last detail is visible, remove the plate and rinse with water from a rose; now if the image is quite perfect, the plate may either be put on one side to dry, or may be at once immersed in the etching bath of water, and sufficient Nitric Acid to make it just taste; keep the tray rocking for about one minute; then it is washed under the tap and rubbed gently with a fine sponge, and dried and gummed ready for inking.

To return to the development of the exposed Bitumen plate, if after being in the turpentine a little time, the image either wholly or partially comes away, then the exposure has not been sufficient, and another trial must be made, giving a longer exposure than before.

If after the plate has been immersed in the turpentine some time, and the image is very slow in developing, the addition of a little benzole will in some cases start the action, but great care will be necessary in making the addition, or the mixture will dissolve the whole of the image, but if after trying the mixture, the image still refuses to appear, then the zinc has been exposed too long.

This process is very simple and easy, and although the exposure is somewhat long, still with practice and experience it will be found reliable, and as before stated for very fine work it is the best process.

The print on zinc in Bitumen being obtained, and bit in as directed above, washed and gummed, when dry it is rolled up with the india rubber roller, charged with stiff litho printing ink, thinned with middle tint varnish, worked upon the slab as thick as it is possible.

The plate being rolled up, any re-touching, bordering or alterations are now made, after which the etching is carried on as directed in Chapter VII.

CHAPTER X.

PHOTO-ENGRAVING ON COPPER.

COPPER Plates being for intaglio or cavity printing instead of using a grained negative, it is necessary to use a positive.

To get at this, the best way will be to make a grained negative by the second method described in Chapter VI, a little larger than required for the copper-plate, then from this enlarged grained negative, make on wet collodion a grained positive the size required, this positive must be thoroughly well exposed, quite free from spots or stains, and absolutely sharp (which of course will not be possible unless the negative from which it was made was also absolutely sharp), and free from veil in the lines.

This positive must be intensified as directed in Chapter I. (as also must the grained negative from which it is made).

A Copper-plate of a suitable size—*i.e.*, large enough to allow a margin of a quarter of an inch all round the picture—is carefully cleaned with fine pumice powder or rotten stone, again using the to and fro motion, and not the circular, then it is coated with the solution of bitumen and spun in the whirler, and when dry exposed to light under the grained positive; after exposure the developement is conducted as directed in Chapter IX. and when a successful result has been attained it is dried and is ready for etching.

Ferric Chloride
Etching on Copper is conducted with a solution of perchloride of Iron in water in a rocking tray, but previous to placing the plate in the etching fluid, the limit of the picture must be marked by ruling lines about a quarter of an inch from the margin, and then covering the space between these lines and edge of plate with bitumen varnish so as to protect the margin from the action of the etching fluid.

The back and edges of plate are also protected by a coat of black varnish, and any alterations and additions made to the picture by means of transfer ink thinned with turpentine, applied by means of a fine sable brush, or by means of an etching needle

or scraper, remembering that to scratch the copper means making a black line in finished proof, and to touch up with transfer ink is to make a light or exactly the reverse of typengraving.

The plate is now ready for the etching bath which is composed of saturated Solution of

(*ferric chloride*) Per-Chloride of Iron 2 ounces.

Water 40 ounces,

place this solution in the etching tray (on rockers like the one used for zinc etching) and keep the plate immersed (rocking the tray all the time) for 10 minutes, then remove and wash under the tap, and remove the dissolved copper by rubbing gently with a very fine sponge, then ink up with a fine indiarubber roller charged with litho. printing ink worked as stiff as it is possible, and keeping the copper-plate well flooded with water, this inking up will fill up some of the half-tones which is what it is required to do, then add another ounce of saturated solution of per chloride of iron and immerse plate again and keep the plate rocking for five minutes at the end of which time the etching should be quite deep enough, clean off the resist and hand over to a copper-plate printer for a proof, and if then some portions require deeper etching, protect those not so requiring by means of either bitumen or shellac varnish and immerse again in the etching fluid without strengthening.

The time of immersion here given is only approximate as much depends upon the permeability of the particular piece of copper, and also upon the subject in hand, but with the above directions, the intelligent experimentalist will soon find out how far to go and when to stop.

For engraving on steel precisely the same method of working must be adopted, using one of the mordants given in Captain Waterhouse's list in the appendix, one etching with which will be found sufficient.



PART II.

PHOTO-LITHOGRAPHY

IN LINE

AND

IN HALF-TONE.



CHAPTER I.

PHOTO-LITHOGRAPHY IN LINE.

FOR this process the original must be in black lines on a white ground, half tones and shades being indicated by hatching or stipple, but no washes of colour are permissible.

Transfers to stone may be made from a print upon zinc, and the instructions given in Part 1, Chapters 1, 2, 3 and 4, are equally applicable to this process, but instead of making an etched block of the zinc, it is handed over to the Lithographer, who will first pull a transfer from the zinc, and then transfer the image to the stone.

If however it is intended to make a photographic transfer direct, then it will be necessary to first make a direct negative in camera (*i. e.* without using the mirror) of the same quality as described in Chapter 2, Part 1, and from this negative, print on a suitable paper the transfer for the stone, this transfer is made upon fine bank post or Saxe or Rives paper, coated with gelatine and chrome alum and dried, then floated upon a mixture of Albumen and Bichromate of Potash, dried and exposed under a negative in the printing frame. After the exposure the print is coated with transfer ink by means of the india rubber roller, or by first coating a lithographic stone with a thin film of the ink, then laying the print upon this face down, and pulling through the press under heavy pressure.

The print is now immersed in clean cold water, and by gentle friction with a fine sponge the image is developed. The print is next dried, and then the image is transferred to the stone.

CHAPTER II.

PRINTING THE TRANSFER.

PAPER for a photo-lithographic transfer may be made by dragging bank post paper through a warm solution of

Gelatine (Nelson's) ... 1 ounce.

Water 20 ,,

Put the gelatine into a wide mouthed bottle or jar, and allow the gelatine to soak until soft, then place the containing vessel in a large saucepan containing cold water, and set on a fire or over gas burner, and by the time the water in saucepan is hot, the gelatine will be dissolved, then add slowly (stirring the gelatine with a glass rod), 2 drams of a 10 grain solution of Chrome Alum, now strain the gelatine solution through fine muslin into a clean dish, standing in a larger dish containing hot water, float the bank post paper upon this solution, (taking care to avoid air bubbles), for two minutes, then lift off slowly, and drag the surface over a clean glass rod, and hang up to dry, pinning by two corners to the edge of a shelf.

When dry, the operation is repeated, but this time the paper is hung up to dry by the two opposite corners, so as to equalise the coat of gelatine.

When dry a second time it must be floated for two minutes upon

White of 5 eggs.

Water 15 ounces,

Shake up well, and filter into a cold dish.

Paper prepared as above will keep for any reasonable length of time.

For use it is drawn slowly through a solution composed of

Bichromate of Potash ... $1\frac{1}{2}$ ounces.

Water 20 ,,

Methylated Spirits of Wine ... 5 ,,

Liquor Ammonia 10 minims.

This being done, the paper is again hung up to dry, this time in the dark room.

Another way of preparing the transfer paper is to soak Autotype single transfer (upon Saxe paper) in cold water until limp, then squeeze down upon a piece of glass free from scratches (previously well polished with talc), where it is allowed to remain until quite dry, when it is stripped off the glass.

It is now floated for two minutes upon

Albumen	...	...	...	...	5 ounces.	<i>1 oz</i>
Water	...	...	...	...	20 "	<i>4 oz</i>
Saturated solution Bichromate of Potash					3 "	<i>1/2 oz</i>
Liquor Ammonia	...	...	...	...	10 drops.	<i>2 oz</i>

and then dried.

Paper prepared as above must be kept in a dry air-tight case, and just before using is laid face down upon a clean smooth litho stone, and pulled through the litho press. After this it is placed in contact with negative in printing frame, and exposed to light until the details are visible.

Although the progress of the action of light can be seen, the frame must not be opened too often, or the paper is apt to expand and blurr the image.

When the print is sufficiently exposed, remove it from the frame, and after coating, a smooth litho stone with Winstone's Photo Litho transfer ink, thinned with turpentine and applied with the india rubber roller, lay the print face down (of course this must be done by yellow light), and pull through the press under heavy pressure. Upon lifting print from the stone it will be found nicely coated with ink.

Now place in clean cold water and gently rub with a fine sponge, and the sensitive Albumen protected from light by the dense portions of the negative will come away, leaving the picture in ink, which after a final rinse is hung up to dry, when it is ready for transferring to stone, which is a purely lithographic operation, and for which directions will be got in *Richmond's Grammar of Lithography*.

CHAPTER III.

PHOTO-LITHOGRAPHY IN HALF-TONE.

THIS process, like Photo-Engraving, has been the subject of many applications to the Patent Office, but the first notable progress made was by Messrs. Bullock, in 1865, who seemed to have gone into the subject thoroughly, as the elaborate and practical specifications prove, but although the patentees issued some fine specimens of their work, and advertised the sale of prepared Paper, nothing came of it.

Messrs. Bullock's method comprises the printing from grained stone—or a stone upon which has been laid a transfer from a stipple plate, or a plate engraved in lines or dots—upon sensitive transfer paper in stiff ink.

A sensitive paper with such imprint upon it is exposed to light under a negative, when the specks of ink form a medium for breaking up the half-tones.

When the exposure is effected, the transfer is covered with ink and then developed as described in Chapter II, and then the image transferred to zinc.

Transfers to stone may be made from a pull on ordinary litho transfer paper in transfer ink, and then laid upon the stone, then to keep the half-tones intact during printing and fill up the broad whites, a transfer pulled very light from a grained stone, or zinc (the grain being of such a size to suit the picture and not bury the detail), or the paper upon which the proofs are to be pulled is first printed upon with a suitable grain, then the photo image printed upon that.

Suitable grain may be got from the machine-made stipple plate as well as from grained stone.

The perfection to which the processes called Collotype and Heliotype have been brought, has proved a great stimulus to the

adaptation to litho printing, so as to get the cheapness of the litho with the beauty of the Collotype, and as the Collotype plate must, to get the best results, bear a certain amount of grain, it is to this process that most experimentalists have turned their attention in the hopes of getting a sufficient grain for litho work.

I have made some very successful transfers from a Collotype plate to a grained stone, but that does not suit all subjects, in fact there is scarcely a process that does so, but to get the best results it is necessary to treat each subject in a different manner.



CHAPTER IV.

INK PHOTOS.

FOR this process we require a drying cupboard fitted with levelling screws to carry glass plates (British Plate $\frac{1}{4}$ inch thick), and which can be warmed to a temperature of 200° by means of hot-water pipes or a calorigen. This drying cupboard must be well ventilated, and in such a manner that the current of air passes evenly over all the plates, as it is very essential that the plates are dried evenly; perhaps the best way of doing this is to have the pipes at the bottom of cupboard, and holes to let in the air just above these pipes and pierced through all round, and an outlet in the centre of roof which should be rather low, let the opening of ventilator in roof be considerably less than the openings in the sides for ingress of air, so that there will be no chance of a quick draught, but merely of a slow even motion of hot dry air; it will also be as well to provide means of being able to control the heat, as the grain is greatly influenced by the amount of heat, and as sometimes a coarser grain will be required than others, it will be necessary that the heat in drying cupboard is entirely under control, and this is better done at the outlet than at the inlet.

The dimensions of the cupboard will, of course, vary with the requirements of the owner, but one 4 feet by 3 by 4 feet high will be found a nice size for a beginning.

The plates are supported upon stout bars of angle iron, and are levelled by means of screws running through the iron. Two tiers of plates may be dried at a time, but it will be found best to have one tier only, as if too thick a coat of gelatine be upon any of the plates in the top tier, it is liable to drip upon the plates in lower and spoil them, but horizontally as many rows as the cupboard will hold may be dried, so long as the outer edges of the plates do not come too close to the sides of cupboard.

The cupboard must be fitted with a thermometer so arranged that the temperature of interior can be seen from the outside.

We also require some pieces of British plate glass a quarter inch thick, ground on one side, which can be done by laying one plate down on a level board, sprinkling a little emery powder on the surface, and after damping the emery, put another plate same size on the top, and rub the two together until both are ground evenly, renewing the emery meanwhile if required.

These plates are coated with gelatine dissolved in water, which is best done in a domestic utensil called "Mary Bain," which consists of a pan of block tin in which is fitted an earthenware vessel, the pan being partly filled with water, and the earthenware vessel holding the gelatine. This pan may be heated over a Bunsen burner or a small parafin stove, either of which will be far preferable to an open fire.

Perhaps it will be just as well here to state that both the drying cupboard and the stove or Bunsen burner must be in a room lighted by yellow light, or by artificial light, as all actinic light must be excluded during the preparation of the plates.

In order that the process may be better understood before plunging into work, a short resumé will be given.

A piece of thick plate glass, ground on one side, is placed upon three of the levelling screws in drying cupboard, and is levelled by the aid of a true spirit level, now warm the plate and coat with a mixture of gelatine and bichromate, varying the thickness of the coat according as the grain is to be fine or coarse, now dry the film of gelatine, which should occupy from two to four hours, then remove from cupboard and expose to light in a printing frame under a positive or transparency until all the details are well printed, then remove and place in cold water so as to wash out all soluble bichromate, then drain, and with a powerful magnifier examine the image, and if there is sufficient grain allow it to dry, but if the grain is judged to be too fine, then immerse in warm water 100° 2 ounces, Ammonia 1 dram, saturated solution of Sulphate of Iron 1 ounce, and leave it there until the grain is sufficiently

developed, which is best ascertained by feeling with tip of finger, now wash in cold water and dry.

This is the outline of the process, now for details.

Place as much cold water into the tin pan of "Mary Bain" as it will hold without spilling when the earthenware vessel is put into it, and into this vessel place

Nelson's gelatine No. 1	...	3 ounces.
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Water	20	"
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Place on stove or Bunsen burner and allow it to remain until the gelatine is dissolved, stir with a glass rod so as to keep all the shreds of gelatine under the water; when dissolved, add Bichromate of Potash 240 grains, and stir well so as to get it all thoroughly dissolved, but take great care not to allow the water in the lower vessel to boil, indeed it should never exceed 150° F.

When all is dissolved, strain through two or three thicknesses of fine muslin.

Place a sheet of thick plate glass upon a levelling stand, and level it thereon, then warm it, and upon the ground side pour sufficient of the strained gelatine to well cover the whole of surface, using a glass rod to coax it to flow to the edges and corners, now allow to remain on the levelling stand until the gelatine has set, then remove to drying cupboard and let it dry, doing the same to as many as the cupboard will hold.

Now close the cupboard, and watch that the thermometer does not register over 120° F or 49° C, nor below 100° F or 38° C. A little practice will soon determine the exact limit, bearing in mind that the slower the drying the coarser the grain, and dried too quickly, and at too high a temperature, there will be no grain at all, and if too high the sensitiveness will be destroyed.

Everything depends upon the above operation, therefore great care must be used, and as it is almost an impossibility to give the exact temperature on account of the ever varying quality of gelatine, it will only be by strict watching that good printing plates will be obtained.

Directly the plates are dry, either gradually cool the cupboard

or remove into a dry chamber so as to keep them free from damp, and expose them to light in the printing frame as quickly as possible, as they do not keep very long.

These plates are exposed to light in printing frames similar to those used in printing on the zinc plates—Part I, Chapter IV.

Exposure to light is effected under a thin transparency, or a paper print may be used, in either case all the details must be sharp and vigorous.

The exposure must be timed by means of the actinometer, Chapter IV, Part I, and as to length, such exposure to light will vary considerably according to the transparency, and the strength of the light, practise will be the only guide, be sure and not under-expose, err rather than on the other side.

On removal of plate from the printing frame the image can be seen, faintly it is true, but still it should all be visible, now place in clean cold water and let it soak therein (changing the water occasionally) for about half an hour, then remove and place in a strong solution of Alum for five minutes, then wash thoroughly and immerse in warm water 100° F., saturated solution of Bicarbonate of Soda 1 dram, saturated solution of Sulphate of Iron 1 dram.

Watch the film closely, as it soon begins to reticulate or pucker, such reticulation being at first very fine and then gradually getting coarser, and if left in too long the whole film will come right away from the plate, therefore remove directly the grain is judged to be suitable for the subject, and at once plunge into clear cold water, slightly acid with Sulphuric Acid, and from thence under the tap, wash thoroughly, then blot off with a piece of old linen rag, using very gentle pressure and then stand up to dry.

When dry, the plate is covered with transfer ink, which is well rolled in with a glue roller, using the ink thick and moist (with turpentine), and continuing the rolling until there is an even coat of ink all over, now with the lower part of the palm of the hand remove all the ink from the surface of the film, leaving it only in the depths of reticulation or grain, when this is done the plate is removed

to the bed of a lithographic press with a roller pressure instead of a scraper, and is laid upon a sheet of india rubber, laid upon a thin litho stone or a metal bed, either of which must be perfectly level and free from grit, or the glass plate will be likely to smash in the process.

The inked plate being in position in the press, lay a piece of ordinary litho transfer paper upon it and pass through the press (the tympan of which must be soft) three or four times, reversing the position of plate each time, then remove and lift away the transfer paper, to which the ink left in the depths of the reticulation or puckers of the gelatine will be found adhering, and which is now handed over to a lithographer for transfer to stone in the usual way.

This process is a combination of three distinct arts, viz., Photography, Intaglio Printing, and Lithography, and to succeed thoroughly in it, some knowledge of all three will be required.



CHAPTER V.

HERE is an alternative process which may sometimes be useful in producing the grained intaglio plate, and as the definite grain is produced in drying, and the plate is already grained before exposure to light, it will suit many operators, and subjects better perhaps than that described in previous chapter.

The thick plate is ground as before, and warmed, then placed upon levelling stand and coated with

Nelson's gelatine No. 1	...	9	ounces.
Water	...	90	"

Dissolve, then add

Glycerine	...	3	minims.
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Bichromate of Ammonia in powder 1½ ounces, stir with a glass rod until dissolved, then add Calcium Chloride (crystals) 2 ounces, stir well, then strain through muslin.

For a fine grain one ounce of this will be sufficient for a 12 by 10 plate, for a medium 2 ounces, and for a coarse 3 ounces, coaxing it to the edges with a glass rod, and being careful not to force any of it over the edges.

The room in which the plate is coated must be kept at a high temperature, say 80° or 90° so as not to chill the gelatine when poured upon the plate, and of course it is understood that the light used to work by must be non-actinic, *i. e.*, daylight filtered through yellow calico or paper ; or gas or parrafin.

The plate being coated, the gelatine is allowed to set, it is then removed to the drying cupboard and placed upon the levelling screws (which have been previously adjusted) the cupboard is then closed, and the plate allowed to remain until dry.

When dry, if the film should split, the gelatine used requires a little more glycerine than given above, but if this does not happen, then examine the grain, and if that is entirely absent, see to the thermometer, and if it registers over 150° F (C 66°) then that is the cause but if the thermometer only registers 120° F,

C 49°, then the gelatine used requires a little more Calcic Chloride.

When all conditions are fulfilled, the plate when dry, will instead of being smooth, present a surface that is best described as composed of a multitude of little hills and hollows of varying size and depth, in other words, instead of being a smooth surface the film will be reticulated or puckered throughout, and the thinner the coat of gelatine the finer the reticulation and *vice-versa*.

Now for a picture with heavy contrasts, a coarse-grained plate will be required, but for a delicate picture full of half-tone, the grain must be small, therefore these plates must be chosen to suit the picture.

For printing upon these plates either a positive picture may be used as in Chapter IV, and the transfer to stone made from the intaglio, or a negative may be printed from, and after exposure to light in the printing frame, roll the plate up with transfer ink thinned with turpentine, using a glue roller as described in Chapter IV, Part I, then, when a thin even coat has been secured, place the plate in cold water and rub gently with a fine sponge, and the image will speedily develope, the ink being removed by the friction from those portions of the film protected by the negative (more or less) from the action of the light, after this the plate is allowed to dry, when it is rolled up with stiff transfer ink, applied with an india rubber roller, then in the litho press a transfer is pulled on ordinary lithographic transfer paper, and transferred to stone. If the negative has been a thin one, allowing the light to act upon the film through the dense portions, the grain will be evenly distributed throughout the entire picture, and very little scraping or doctoring will be required on the stone, but if the picture has been printed from a dense negative, the whites will be almost, if not quite, devoid of grain, in which case it will be necessary to choose a grain or stipple to suit the picture, say a finely grained stone or zinc, or a transfer from a suitable grained plate; which being ready, transfer the print of picture in position upon it, and from that print the copies.

Printing from any of these transfers must be entrusted to a skilful lithographer, as no amount of description can give all the dodges requisite to make a presentable print from the transfer as at first laid down from the photo plate, and it is a wonderful sight to compare the first pull with that which is at last pronounced "all right."





APPENDIX.

GENERAL HINTS

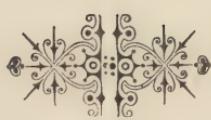
AND

EXTRACTS

FROM THE

PHOTOGRAPHIC NEWS

Of Useful Methods of Working.



APPENDIX.

GENERAL HINTS.

IN giving formula and directions through this book, it has been my aim to avoid complication by the omission of all alternative methods and formula, but as in ordinary photography, a method or formula that with one operator is quite satisfactory, with another either indifferent or useless results are only obtained, why this should be so is very difficult to account for, but the fact remains ; therefore to give all workers a chance of getting out of any difficulties, I propose to take the subject, chapter by chapter, and make suggestions as to how failures may arise, and so far as possible give the remedies.

THE STUDIO.

THE floor of this room must be perfectly solid, as the slightest vibration of the Camera during exposure will be fatal to the work in hand.

The dark room must be of ample size to allow plenty of room to move about in, and if it can be divided into two (one small portion to be devoted to the silver bath and collodion, and the other to the rest of the operations), so much the better : above all, have plenty of light to work by, as it is impossible to get good negatives if working in semi-darkness, all that is needed is to employ a good medium, through which a bright yellow light can filter.

The Camera and dark slide must be strong and rigid, built for strength, not portability.

The lenses used must be of the triplet or rectilinear type, and if by a good maker will give no uneasiness.

The mirror is a piece of perfectly plane glass, coated on the surface with a thick film of pure silver, and highly polished, This silvered glass must be mounted in a mahogany box and fitted on the front of the camera, the lens being fitted in front of the

mirror, see Fig. I, Page 8., the mirror is placed in loose grooves at an angle of 45° from axis of lens, and so situated, receives the image projected by the lens, and reflects it on to the focussing screen or sensitive plate in camera, by which means a negative is obtained, which when looked through with the film between the operator and the glass, the image is in its proper position, whereas if the lens be used without the intervention of the mirror, it will be necessary to have the glass between the eyes and the film to get the image in its proper position, and as the generality of photographic negatives are taken without the intervention of the mirror, they are called ordinary negatives in contradistinction to those made through the mirror, which are called "reversed" negatives.

The silver surface of the mirror requires great care and attention to preserve its lustre from tarnish, which would make the exposure in the camera longer, besides which, the cost of re-silvering is too great to allow of the surface being spoilt too frequently through carelessness.

At the end of each day's work, remove the mirror from the box and warm it in front of the fire (not over a gas flame) just slightly, and wrap it carefully in a piece of fine velvet, which has also previously been warmed, then wrap up in a piece of india rubber or macintosh cloth, and put away in a air-tight box, by doing this, the mirror if well silvered at first will last for a year or two.

If the surface should get scratched or tarnished, get a square of very fine chamois leather, and place in the centre a pellet of cotton-wool, then gather up the leather, and tie the wool in the centre, making a small globe about an inch-and-a-half in diameter, now warm the mirror, and after dipping the leather globe into fine rouge, proceed to polish gently with a quick circular motion, using little or no pressure,—take care in doing this that the mirror, the leather, and the rouge are quite dry, else the silver coat will come away—*verb sap*.

In focussing the image upon the ground glass, great pains must be taken to get absolute sharpness all over the plate, else the resulting negative will not yield a proof fit for etching on the

zinc, and be sure not to try and get the lens to cover a larger area than it can, but rather let the lens be always employed well within its power, for instance, a lens of 12 inches focus in ordinary photography will cover a plate 10 inches by 8 inches, but for the class of work under consideration, $8\frac{1}{2}$ by $6\frac{1}{2}$ will be quite as large as a 12 inch lens ought to be called upon to do.

Up to Chapter III, Page 21, the directions given require no comment or addition, but as the production of a suitable negative is the foundation of success, it will not be a waste of time or space to say that a perfect negative for photo-zinc printing taken from a suitable drawing, must, when laid upon a sheet of white paper show all the details sharp, clear, and free from veil, all black lines in the original showing the white paper underneath, and those portions representing the white paper of original must when examined by transmitted light be quite or nearly black. The words "taken from a suitable drawing" have just been used, and herein will lie a good deal of the success or failure of a beginner, through not knowing the difference between the results from a line and from a washed drawing.

For Photo-zinc printing in line, no washed drawing can be used, all subjects must be in line, drawn in good black ink on smooth white paper, all lines to be firm and bold, and when drawn for photographic re-production should be done three or four times larger than the contemplated block.

In Chapter III, when zinc plates from carelessness or other causes, alone are scratched too deeply for removal by means of emery cloth and turpentine, then a piece of flat pumice stone must be used, and as not only must the plate be free from scratches, but it must be quite level, therefore the surface will require to be rubbed away all over, and so remove the scratches and level the plate ; use a good sized piece of pumice stone, grinding a flat surface upon it, at right angles to the grain ; with this rub the surface of the zinc (to and fro only), keeping the zinc well supplied with water, and taking care to grind the metal away evenly.

When the scratches are removed, polish with emery cloth

and turpentine, and give final polish with an oil rubber as used by engravers, consisting of a roll of fine cloth with end cut square with a sharp knife, the roll being tied tightly together. This rubber is used with fine olive oil, and in a to and fro direction only, *i.e.*, not in circles, a little powdered charcoal and the oil may sometimes be used to re-polish copper-plates scratched or with a dull surface, finishing with the oil rubber alone.

Engraved plates will be much improved if the surface be polished with the oil rubber after mounting and before printing. In graining the plate previous to coating with the bichromated albumen solution, care must be taken not to have the acid too strong, else the surface will be rough instead of finely grained, and if that is so, the rough surface will tend to produce rotten lines, especially among the fine ones ; as stated before, the function of the alum is to keep the surface bright and not dark coloured, as would be the case if no alum is used.

In using the whirler if any trouble be experienced in getting it to spin in one hand, a piece of iron 9 inches long may be screwed to a steady bench, the iron at end having a half circle aperture, and projecting about 6 inches from the bench, then when the plate is in position, press the shank of whirler against the indentation in the end of iron, and with the left hand firmly grasp the top of the carpenter's brace, with the right revolve the plate in the same manner as if boring a hole with the brace.

In etching zinc plates, the greatest care must be taken in the first rolling up, to preserve the finest lines sharp and clear, else the first etch will not leave them as they ought to be, clean cut.

Instead of coating the back, edges, and those portions of the front of zinc plate not occupied by the image, with bitumen varnish (which is merely made by dissolving asphaltum in ordinary benzole) ordinary white hard varnish may be used, or shellac, dissolved in methylated spirits of wine, laid on with a camel's hair brush.

Powdered asphaltum passed through the 120 hole sieve may be used instead of powdered resin, and by some operators is pre-

ferred ; certainly it does not cling to the metal like the resin, but it requires a much greater heat to melt it than the resin does.

The ink for the advanced stages of the etching may be for deep etching, advantageously mixed with bees-wax, fine tallow, or palm oil, and a trace of venice turpentine all melted together and whilst hot, the ink and above ingredients well mixed, and after mixing kept on the fire a little time, but as these inks are best made by professional ink makers, it will be far best to buy them ready for use, which will be the cheapest in the end.

In inking up between the various etchings, be sure that the ink is well distributed upon the roller, and above all, that it is not worked too thin. Do not be in a hurry over the etching keep the acid bath as weak as possible, as if used too strong gas will be evolved, the weak points of the resist found out, and the block spoilt.

As stated before, never let the acid get unpleasant to the taste, then there will be no fear of harm.

In clearing the sides of etched lines from the burr left by each etch, the following extract from the *Printing Times* and *Lithographer*, will suit some cases.

After the original resist is cleaned off, warm the zinc on the hot-plate, and with a strong 'flexible roller, ink up with printing ink one-third, resin one-third, yellow wax one-third, this ink being thoroughly melted and incorporated, and *used warm*. This ink, which can only be used warm, descends upon the sides of the lines, and when it has reached half way down the slope stop the inking, and allow the plate to cool, then further ink with cold ink, so as to ensure the face being well covered, then immerse in etching bath, and after removal wash away acid, then clean off the ink, and again roll up with cold ink so as to preserve the surface, and in a weak acid bath remove the rest of the inequalities.

For etching the half-tone blocks no resin or asphaltum is required, the ink resist being sufficient to prevent any undercutting, and the acid bath must be used very weak, as so very little depth is required.

Some operators instead of entirely depending upon timing the duration of each etch, make a scratch in the varnish on the edges of the plate, and by occasionally feeling its depth with the finger nail, judge of the effect made by the acid, making a fresh scratch each time of etching, and for making such scratches care is taken that such an instrument is used, that whilst going through the varnish it not does mark the zinc, as if it did so the effect would be nullified, as it would be impossible to judge how much of the depth of the scratch was due to the acid, and how much to the scraper.

I have endeavoured to give as explicit directions as to enable even a tyro to succeed, but experience will be the best teacher after the rudiments are learned, therefore, to be a successful etcher, first follow the directions as here given, and afterwards adopt such modifications as observation and practice dictate, above all, remember in all this process in addition to the ingredients mentioned for each stage or method there is one not given, but it is essential, and that is the medium a celebrated painter once told an enquirer as to what he mixed with his colours, viz., brains, sir, brains.

In making the screens for the half-tone blocks, the most extreme care must be exercised in getting the lines absolutely sharp from corner to corner, and also in making the grained negative from the screen and transparency in contact, the lines on screen must be absolutely sharp and distinct.

For making small half-tone blocks, it will neither be necessary or desirable to use a large lens, the only necessity being to use a lens that will thoroughly well cover the block intended to be made, as for instance, for a block 4 inches by 3 inches, a lens with a focus of seven or eight inches will be as large as will be needed.

For grained half-tone negatives it is neither possible nor necessary to get such opacity as in line negatives, but in both the lines must be clear glass, else a firm print on zinc will be difficult or impossible to get.

THE USE OF GELATINE DRY PLATES IN PHOTO-ENGRAVING.

INSTEAD of using the Wet Collodion process for making negatives (in line or half-tone) for Zinc Printing, Gelatine Dry Plates may—under certain conditions—be used, but the only advantage to be gained by their use being rapidity of exposure in the camera, their general use cannot be recommended ; but as in the course of business, circumstances are sure to arise when this advantage will far outweigh any drawbacks, it will be as well to provide for this contingency by giving directions for their use.

In the first place until the demand for a suitable plate puts a special plate in the market, great caution must be observed in using ordinary plates, choose a slow plate such as Wratten's ordinary plate, and after exposure develope with—

Saturated solution of

Oxalate of Potash 4 drams.

Saturated solution of

Sulphate of Iron 1 drams.

60 grain solution Bromide of Soda 5 minimis.

be sure that the Oxalate of Potash is rendered decidedly acid with Oxalic acid, and the Sulphate of Iron with Sulphuric acid.

After exposing the plate (which will be 10 or 12 times *less* than that required for a wet collodion plate) lay it face up in a clean flat bottomed dish and, after mixing the developer by first of all pouring the Oxalate of Potash solution into the glass measure, then add the Sulphate of Iron solution and lastly the Bromide solution ; pour the mixture into the plate, rock the dish a few times, then cover up the dish and leave it undisturbed for a quarter of an hour or so, then examine and if the image looks black enough wash and fix in a solution of Hyposulphite of Soda 6 ounces, Water 20 ounces, which will dissolve away the unaltered Bromo-iodide of Silver, then wash carefully and lay the negative face down upon a piece of clean white paper and see that the lines are free from veil as if not the negative will be useless, the principal sources of failure in this process will be over exposure

so be very careful and do not over time, another caution is to see that the window of dark room is covered with an extra thickness of canary medium or golden or cherry fabric as these plates will not stand the amount of light a wet collodion plate will.

Instead of using the Ferrous Oxalate developer, Pyrogallic acid may be used and will—if the plates are good—be much more under control.

This developer is made up of—

Sulphite of Soda	...	...	4 ounces.
Water	...	...	40 ounces.

dissolve the Sulphite then add Citric acid 30 grains, when this is dissolved add 1 ounce of pyrogallic acid and label No. 1.

In another bottle of a different shape dissolve—

Bromide of Soda	...	...	1 ounce.
Water	...	...	20 ounces.
Liquor Ammonia 880°	...	...	1 ounce.

and label No. 2.

The plate being exposed in the camera take dark slide into the dark room and removing the plate lay it face up in a clean dish and (for a plate $6\frac{1}{2} \times 4\frac{3}{4}$) pour over it $1\frac{1}{2}$ ounces of solution No. 1, see that the solution covers the film and allow the solution to well permeate the film, then into the measure glass pour 2 drams of solution No. 2, then pour solution No. 1 from the dish and apply the mixture which if the exposure has been right, will in the course of from three to five minutes, develope the image, and a prolonged immersion of plate (keeping the dish rocking all the time) about ten minutes will give sufficient density to the image. The developement being completed wash well under the tap, then immerse the plate in a solution of alum at about half saturation for five minutes, again wash for at least five minntes, then immerse in the Hyposulphite solution which will dissolve away the unaltered bromo-iodide of silver, again wash, and place the plate in contact with a piece of white paper to see if the lines are clear and free from veil.

In making transparencies for the production of half-tone

blocks the pyro developer will be the best, but so long as the shadows are dense and the lights full of detail, there will be no necessity for any further test.

For making transparencies same size of original negative the best plan is to place a large sheet of white paper in front of the copying camera, and rack the lens out of focus, taking care that the white sheet of paper is sufficient to illuminate the full size of plate, then in the dark room place the negative in carrier of dark slide film side up and carefully dust the surface (also seeing that back of negative is clean) with a clean camels hair brush, dust also the film of a gelatine dry plate, and place it face down upon the negative, close the slide, and insert it into the grooves of camera and expose to the light reflected through the lens from the white sheet of paper for from 5 to 20 seconds according to density of negative and intensity of light, close the lens and the shutter, and remove into the dark room for development.

By exposing a plate in this manner there is a far better chance of getting absolute contact between the two plates, as the rays of light are parallel.

For making transparencies for printing upon copper-plates, first of all make a grained negative the proper size, then when this is varnished and touched up make from it as above a transparency upon a gelatine chloride dry plate, by which process it is more certain to get a suitable result for the process than on a gelatine bromide dry plate.

No formula will be given here for developing these gelatine-chloride plates as each packet has full instructions for development which must be followed implicitly.

It will sometimes happen that a transfer or a zinc is required of larger dimensions than the camera will take, in which case the original must be copied in sections, and each section printed upon zinc, transfers pulled from each, then these transfers cut to fit and the whole laid down upon a plate or stone the size required, in doing this class of work, once the camera has been adjusted it must not be moved, but the original must be moved on the

copying easel each time a fresh portion has to be brought in the axis of lens; another dodge that may sometimes be useful for commercial work is that of making a block with white letters on a black ground from an original in which the letters are black on a white ground, this is done by first of all making a direct negative, *i.e.*, without using the reversing mirror, from the original the size wanted, then from this making a transparency by any of the methods given above, and from that transparency making a print upon zinc.

HINTS FOR PHOTO-LITHOGRAPHERS.

BY PROFESSOR G. SCAMONI.

From the Photographic News, April 3rd, 1885.

RETOUCHING LINEAR PHOTO-LITHO TRANSFERS.

IT very often happens that pen-and-ink drawings which are intended for photo-lithographic reproductions are so unsuited for the purpose, that it is next to an impossibility to obtain a negative with the details well out and clear hair lines; in fact, it is only by judicious retouching upon the stone that anything like satisfactory prints are obtainable.

In order to do this, proceed as follows:—The gummed-up image on the stone, after having been, as usual, rubbed over with re-transfer ink, etched with weak acid, and rolled in with litho ink of a middling consistence, is powdered over with French chalk, to prevent the fresh colour from smearing, and then brushed over with a thin etching ground, composed of jeweller's rouge (*caput mortuum*) and weak gum-water. This transparent ground materially assists the work of going over the delicate lines and faintly visible details of the photo-lithographed picture with the engraver's needle.

Particular care must be taken that the point of the needle penetrates but slightly, and to an even depth, into the surface of the stone. As a gauge, the depth produced by the scratch of a writing diamond, or diamond splinter, under slight pressure of

the finger, may be taken as a guide. Points made of broken-off diamond splinters, and known as toothed ones, are especially useful for broad lines, but for filling in larger shaded portions, roulette tools* of different forms may be used.

When the engraving is finished, dab the parts with a little palm oil, and after the lapse of a few minutes, to allow the fat to penetrate, rub up the whole picture with re-transfer ink, until the newly-made lines appear as black as those of the transfer itself. Now gum in the stone, and when dry, or a few hours later, roll in with re-transfer ink ; afterwards re-gum, and proceed to clear out any thickened or smeared portions of the design, and finally etch with gum, acidified with dilute phosphoric acid. Clearing out is best done with a broad etching needle, ground flat, and sharp pointed skewers of wood, dipped into diluted phosphoric acid mordant. If any portions of the design should appear weak or rotten after the second rubbing up, it is advisable to go over them with litho writing ink before the final etching is proceeded with. In this manner one is able to execute a perfectly satisfactory reproduction from a really defective original, without the least detriment to the artistic character of the drawing.

ZINC PLATES COATED WITH CARBONATE OF LIMF

I MAY embrace this opportunity of bringing to notice the calcareous-surfaced plates lately introduced by O. Muller of Leipzig ; these, being a good substitute for the expensive Selenhofer stones, deserve special merit on account of their adaptability for cheap transportation, besides other excellent qualities. The calcareous coating, which is upon thin sheet zinc, and hardly a millimetre in thickness, is as even as the ground surface of a lithographic stone, and can be employed for engraving purposes as well as for transfers and direct drawing with the pen.

The manufacturer supplies beds of wood, or iron, in any desired size, upon which the plates are fastened by means of

* A. F. Renard, of Paris, Rue de Gravilliers, 24, makes the best tools. A very instructive proof-sheet, showing a variety of roulette and berceau tints, can also be obtained there.

stretchers, for printing upon in the steam press. The following etching fluids are recommended for use with the plates :—For direct writing and transfers, add four parts of phosphoric acid to a solution of 25 parts of picked gum-arabic in 100 parts of water. For chalk or crayon drawings, to a solution of 25 parts of gum in 100 of warm water add 1 part of phosphoric acid. Full instructions for using the plates are to be obtained of the manufacturer. For photo-litho and zincography I can recommend the following mordants : boil down 160 parts of gall nuts with 1,500 of water until reduced one-third, filter, and add 125 of thick gum, and 6 of phosphoric acid. No. 2, add a strong solution of tannin to the ordinary weak nitric acid etching fluid until it assumes a brown colour.

A METHOD OF STRONGLY ETCHING A STONE.

I recommend the following method when it may be necessary to subject an image on stone to a very energetic etching, and it is of special importance not to lose the finest detail. The stone is inked in and gently etched in the usual way, after which it is washed and fanned quite dry. It is next dusted with fine resin or asphalt powder, and the excess is carefully brushed off with a powder puff, when a sheet of hard glazed paper is laid on the stone, and it is passed through the press.

The stone is now levelled, and its surface covered with proof spirit, and this is immediately lighted, taking care that the steadiness of combustion is not interfered with by air currents. As the spirit burns out, the resin and the fatty ink become thoroughly united, just in the same way as they unite when a zinc plate is heated at the back in preparing it for etching. When the stone is cold it may be etched very freely ; indeed, so much as to leave the image in very perceptible relief. For etching stones prepared in this manner, I prefer dilute phosphoric acid and gum rather than nitric acid, and in inking up I use an ink which has been mixed with a solution of asphalt in turpentine.

EXTRACT FROM "MODERN PHOTO-LITHOGRAPHY."

BY HENRY BUTTER.

Photographic News, March 19th, 1880.

THE photo-lithographic paper is prepared by dissolving separately three ounces of the best gelatine ("Nelson's opaque" answers very well) in forty ounces of hot water, and two ounces of bichromate of potash in ten ounces of hot water; the two solutions are mixed together, and should then be kept from the light. When required for use, the beaker or other vessel containing the mixture should be immersed in hot water for the purpose of liquefying the gelatine, which may then be poured into a flat porcelain dish, placed within another containing hot water, and the paper is then floated in the liquid for about seven or eight minutes, the corners being lifted, and all air-bubbles carefully dispersed, so as to ensure a perfect coating; the sheet is then raised, drained over the dish, and hung up to dry, after which the process is repeated. Bank post paper is found to be the most suitable and before its preparation one side should be marked, so as to readily distinguish the prepared surface. The whole of this operation must, of course, be conducted in a dark room.

When perfectly dried after the second coating, the prepared paper should be laid face downwards on a polished lithographic stone heated, or polished steel plate heated, and passed through the press, in order to give it a smooth, uniform surface, care being taken that no light gets to it, to ensure which, in this, as in subsequent operations, the lithographic press should be in the dark room, or used at night, or the stone may be lifted from the press, and taken into the dark room each time it is necessary to handle the paper on it, using several folds of yellow paper as backing sheets, to protect the prepared paper during the transit.

The operation of printing is precisely the same as with albumenized paper, extra care being, however, needed that no light reaches the print. As the printed parts are of a yellowish brown colour, while the whole surface of the paper is of a deep yellow

the difference between the two is scarcely discernible in the yellow light of the dark room ; but the operator must not be tempted to examine the progress in daylight. It is also of the utmost importance that the image should not be over-printed, for if the action of the light extends to the general surface of the paper, it is altogether impossible to succeed in clearing the print in the next process ; if, on the other hand, the image be under printed, there is a great probability of the finest lines being rubbed away.

Inking the print is the next stage in the process after exposure and again brings the lithographic press into requisition. The greasy ink used may be either the common litho-retransfer ink, with which by far the most satisfactory results have been obtained, or the following :--Grind together two pounds of chalk lithographic ink, and one pound of middle linseed varnish, melt in an iron ladle four ounces of Burgundy pitch, and add gradually two ounces of palm oil and two ounces of white wax, stir the mixture till it burns, and then put in the ink and varnish in small quantities at a time, stirring the whole well altogether. When required for use, a small portion is melted with sufficient spirits of turpentine, so as to give it, when cold, the consistence of treacle.

To ink the print, a polished lithographic stone or polished steel plate (having been cleaned with spirit of turpentine, if it has been used for the same purpose before) is charged with a very thin coating of the ink by means of a litho-roller, and the print laid face downwards upon it, and passed through the press, using a rather lighter pressure than in ordinary printing ; on taking up the print it should be found uniformly covered with a thin tint of a black ink ; the thinner the layer of the ink, the sharper and finer will the drawing come out.

Removing the superfluous ink is accomplished in the following manner :—Prepare some strong gum-water, and warm it slightly ; pour some hot water (about 100° Fahr.) into a flat porcelain dish, and upon it float the inked print, face upwards allowing it to remain until the warm moisture has penetrated the gelatinous film—which will be known by the appearance of in-

numerable glossy patches over the surface of ink—then pour off the water, leaving the print evenly spread on the bottom of the warm dish, and wash it very carefully with a soft sponge and the warm gum-water. If the gelatine is of good quality, the negative sufficiently opaque, and no light has been permitted to reach the print beyond that which passed through the transparent parts of the negative, the coating of gelatine, and with it the greasy ink on its surface, will be removed from the paper with the lightest touch of the sponge, leaving behind such portions of the composition only as have been made insoluble by the action of light, and which, consequently, also retain the ink on them, gum-water being incapable of attacking the grease and removing it from the paper, unless it can do so by first dissolving away the foundation of gelatine upon which it rests.

When all the superfluous ink has been removed the print is washed in several changes of tepid water (not so warm as before) and hung up to dry. A careful examination will now point out any errors in the foregoing process. If the fine lines which lie close together, or the angles formed by the junction or crossing of the lines, are filled in with ink, and the drawing generally appears rough and wanting in sharpness, there has been too much ink on the stone in the inking process : if, on the other hand, the lines are very sharp and fine, but extremely pale and wanting in sufficient body to transfer themselves to stone, there has been too little (a very rare fault). If the ink leaves the paper sluggishly, and there remains behind a dark scum in patches over the drawing, light has affected the paper either through the negative not being sufficiently dense (a very likely cause,) or from carelessness in conducting the operations. If the lines are broken, and exhibit a tendency to leave the paper, the print has been exposed too short a time to the light ; whilst if the thick lines, dots &c., are firm and sharp and well-defined, and the fine ones rotten or feeble, the negative itself is at fault, having its fine lines partly covered up in the intensifying process. This fault is not so easily discerned on looking through the negative as may be imagined as the filling up frequently consists of a

thin yellowish veil, transparent to the eye, but chemically opaque, a fault generally due to over-exposure and carrying on the developement too far, and occasionally due to insufficient washing after fixing.

The transferring to stone is performed in the same way as with an ordinary transfer.

COLAS' BLACK PROCESS.

THIS process will often be found useful to re-produce a drawing on yellow tracing-paper, so as to give a more suitable copy to photograph from.

Coat with a fine sponge a hard, well-sized paper, with

Water	-	-	300	parts
Gelatine	-	-	10	"
Per-chloride of iron (dry)			20	"
Tartaric acid	-	-	10	"
Per-sulphate of zinc	-		10	"

and dry in the dark room.

When dry expose under the tracing until the greenish-yellow tint of the paper has disappeared, except where covered by the opaque lines.

Development is effected in a bath made by dissolving 20 parts of gallic acid in 200 parts of alcohol (methylated) and 1000 parts of water, then wash in plenty of clean water.

ON A NEW METHOD OF PHOTOGRAPHIC ENGRAVING.

By J. R. Sawyer. Read before the Photographic Society of Great Britain.

IF we examine a photographic print in pigmented gelatine, produced by the autotype process, we shall find that the effect is produced by varying thicknesses of gelatine and pigment corresponding to the lights and shades of the original negative.

It necessarily follows that a picture of this description must be in relief, the deep shadows consisting of masses of gelatine and pigment fixed by the action of the light through the more transparent portions of the negative, whilst the pigmented gelatine in the half-tones and high-lights, being partially or wholly soluble, has been to that extent got rid of in the process of development. It is a picture of this kind, developed upon the rigid surface of a metal plate, that forms the basis of the mode of producing printing surfaces that I propose to call your attention to this evening. In order that you may easily follow me I will preface my remarks with a short summary of the necessary conditions :—

First, there must be a photograph in relief developed upon a rigid surface.

Second, this photograph must have a tooth or grain given to it.

Third, the surface of this photograph must be rendered a sufficiently good conductor of electricity as to make it possible to deposit upon its surface, without the least injury to the picture, a coating of copper.

With respect to the first condition, a picture in relief is easy to obtain if a carbon picture is developed upon a rigid surface ; as colour is of no consequence, there is a considerable choice of material to work with, and that particular tissue can be chosen which gives the proper amount of relief. To ascertain what is the proper amount is by no means an easy matter, and many experiments made with tissues varying in their proportion of gelatine and colour have had to be worked out to settle that question.

The amount of relief in any given picture may depend on either of two causes, one being the quality of the negative, the other the proportion of pigment to gelatine in the tissue. A tissue containing a large proportion of colouring matter with respect to gelatine will give a low relief, whilst, if the gelatine is increased without altering the quantity of colour, a high

relief will be the result. The quality of the negative also affects the amount of relief, prints from weak, thin negatives having but little relief, whilst prints from vigorous negatives, even with the same tissue, show very much more. This fact will quite explain why pigment prints from negatives having different densities appear to be of different colours, although made in the same tissue.

One of the principal difficulties in this mode of photographic engraving has been the question of relief, and I hope to show you presently how it has been successfully combated, and the whole process so simplified as to enable photographic engraving to be carried on with comparative ease, and with every chance of successful results.

Let us now consider the question of obtaining a tooth or grain in the picture sufficient when electrotyped to give the plate the property of holding printing ink.

It is quite possible to develope a picture in relief on a metal plate, and when dry to make its surface conducting by means of plumbago ; a copper-plate can be obtained from this, which reproducing accurately all the lines and details of the original seems as if it might be made to print ; it is placed in the hands of a copper-plate printer, who inks it with his dabber, and then proceeds to wipe out the superfluous ink. But here the trouble commences ; not only does he wipe out the superfluous ink, but *all* the ink, and the plate is useless, because it has no ink-holding grain.

Many methods have been tried to overcome this difficulty, but the only successful one, so far as I know, is one invented by my friend Colonel Waterhouse, and worked out with him by Mr. Foxlee and myself at the Autotype Works. This method consisted of covering the gelatinous image, whilst still wet, with very finely-powdered glass. As this powdered glass is laid upon the moist and yielding surface of the picture, its minute points and angles penetrate it, and as the gelatine contracted in drying it became still further embedded. The glass being then brushed out of the

film, a series of minute holes was left, which, when reproduced in the process of electrotyping, gave the necessary ink-holding grain.

The third requirement that our relief picture must possess, is a surface that can be rendered sufficiently conductive of electricity, to enable a coating of copper to be deposited upon it before the solution in the depository vat or trough has had time to act upon the gelatine image, for it is evident that if the smallest disturbance of the gelatine surface takes place, it will be fatal to the result. This has been sought to be accomplished by rubbing the surface of the gelatine picture with finely-powered plumbago, but great care has to be taken not to block up the delicate portions. The picture being developed upon a silvered-copper plate (in itself a good electrical conductor), the deposit of copper occasionally takes place in a satisfactory manner, and very good work can be produced, especially if the subjects have not any very deep shadows, the heavy masses of gelatine forming, which are difficult to coat, and if the fluid attacks them before the coating of copper becomes continuous they will break up, and the plate will be useless. Another difficulty arises if every particle of the powdered glass, used to form the grain, has not been thoroughly got rid of, showing itself at this stage by marks across the plate, beginning wherever a little particle of glass has been left in the film.

We have thus seen that the requirements for the easy and successful practice of this mode of photography are :—

A picture in pigmented gelatine having the proper amount of relief, having also a grain which can be varied to suit different kinds or sizes of subjects, and, in addition, be in itself a good conductor of electricity. To meet these requirements I have invented and patented a new tissue, containing amorphous graphite or plumbago in grains of different sizes, and the quantity of this material so proportioned to the vehicle as to give the amount of relief calculated to produce good effects with negatives of the usual kind. Specimens of these tissues will be handed round—No. 0 being the finest, No. 1 the medium, and

No. 2 the coarsest grain. Thus, the reproduction of a small portrait or landscape, or copy of a drawing or line subject, will be best done in the tissue having the finest grain ; larger sizes of plates, say up to 15 inches, will be better suited by No. 1 tissue, whilst for large copies or pictures and subjects, in which a great range of tone has to be represented, the comparatively large grain to be found in the No. 2 tissue will be desirable.

By the use of the graphite, not only do I obtain the amount of relief and the quality of grain required, but this material has the advantage of being one of the best conductors of electricity, and as it is present in comparatively large quantity in the picture—most of the gelatine being washed away in the act of development—it forms a very suitable conductor for depositing copper on the surface by means of the electric current.

In previous methods of forming a printing grain it has always been found that the graining material did not take sufficiently in the deepest shadows, probably because the grain was *outside* the film and not in it. By having the grain *in* the film it is present in larger quantities in the shadows, and thus gives depth and richness to the prints.

OBERNETTER'S PHOTO-ENGRAVING PROCESS.

Photographic News, Feb. 1st, 1884.

A dia positive is made on a glass plate coated with a minium of gelatine containing a maximum of sensitive silver haloid the film is then stripped from the glass and treated with a mixture of per-Chloride of Iron and Chromic Acid, so as to convert the whole of the silver in the image into Chloride. This film is then placed in contact with a copper plate, and the copper gradually decomposes the silver chloride, metallic silver being liberated, this decomposition of course being accompanied by a corresponding etching of the copper plate.

It has been found that a collodion positive or an ordinary Gelatino Bromide transparency may be converted into a Chloride

picture, when it easily etches a copper plate when pressed in contact therewith.

Mr. E. de Zuccato's method being found the most convenient or converting the silver image into Chloride, viz.: by treating with a dilute mixture of Hydrochloric Acid and Potassium Bichromate, and if the film before being placed upon the copper be moistened with a weak solution of Zinc Chloride, the etching proceeds more rapidly.

KLIC'S PROCESS FOR INTAGLIO PLATES,

Photographic News, Feb. 1st, 1884.

A COPPER-PLATE is dusted with powdered Asphalt, and the plate heated, so that the asphalt becomes nearly melted.

A negative carbon print is now transferred on to the copper-plate, and the plate, now covered with the negative in carbon (or pigmented gelatine) is etched, first in a strong solution of per-Chloride of Iron which penetrates only the thinnest parts of the picture; then by a weaker solution of the same salt etching through the thicker portions of the pigmented gelatine.

By employing more and more dilute solutions of per-chloride it is possible to etch through thicker and thicker layers of pigmented gelatine so that only the high lights remain unetched.

ASSER'S STARCH PROCESS.

"Photographic News," April 27th, 1883.

UPON a slab of glass lay a sheet of white blotting-paper, and dab over with thin starch paste, a soft sponge being used for the purpose, care being taken to apply only sufficient starch paste as will fairly sink into texture of paper.

Now dry the sheet, and when dry float the starched side face down on a five per cent. solution of Bichromate of Potash for five minutes, and hang up to dry in a moderately warm dark room,

and when again dry, expose under an ordinary negative for about two-thirds the time that would be necessary to obtain a print on ordinary Albumenised paper.

When the exposure is complete, soak the print in cold water until all traces of unaltered Bichromate of Potash are removed.

The wet print is now partially dried by means of clean blotting-paper, and then exposed to the air until quite dry, after which it is laid between sheets of ordinary white paper, and well ironed with an ordinary flat-iron, heated to about 150° F ; the object of this proceeding being to harden the starch, and enable it to hold the fatty ink firmly.

Now moisten the sheet, and lay it upon a sheet of damp blotting-paper, and ink up with a velvet roller charged with rather thin lithographic transfer ink. This ink adheres to the exposed portions, (which refuse to take up water) as a kind of granular deposit, leaving the thoroughly damp portions white and clear of ink.

The stippled ink picture thus obtained is then laid upon a prepared zinc plate, and etched into relief as described in Part I, Chapter VII. In continuation of the above, Mr. E. J. Asser, on page 72, *Year Book of Photography for 1885*, says ;—

“ Before the image on the damp paper is inked, one should apply by means of wadding or a soft pad, a very thin layer of mastic varnish diluted with alcohol, and thinned by a considerable addition of turpentine; and a gentle dabbing kept up until the solvents have evaporated. A roller covered with velvet is used for applying the transfer ink, and soon the image appears, clear and vigorous, and any superfluous ink that may adhere to the white is removed by carefully dabbing with a moist pad or wadding.

The most simple and sure transfer ink, for both lithography and zincography consists of common lithographic printing ink—not transfer ink—mixed up with oleine till it forms a supple, but rather substantial mass.

These transfers can be laid upon zinc or stone, and printed

from as lithographs, as well as being transferred to zinc for etching.

THE PRETSCH PROCESS FOR MAKING PHOTO TINT BLOCKS
FROM ORDINARY NEGATIVES.

(*From Year Book of Photography, 1886.*)

DISSOLVE 1 ounce of Coignet's Gold Label Gelatine in 6 ounces of distilled water, and to 1 ounce of this solution add 30 grains of Nitrate of Silver, previously dissolved in $\frac{1}{2}$ an ounce of distilled water; to the other 5 ounces of Solution of Gelatine, add 2 ounces of a saturated solution of Bichromate of Potass (saturated at a temperature of 60° F), and whilst still warm, add to it the gelatine solution, containing the Nitrate of Silver; (which solution has also been kept warm), stir up well with a glass rod during addition and continuing the stirring, add 100 grains of Crystallised Calcium Chloride, and when dissolved, add 150 grains of glycerine, which must also be thoroughly mixed with the gelatine solution.

2. Level a glass plate ($\frac{1}{4}$ inch thick, and rather coarsely ground with emery powder), and pour over it as much of the above solution, as when dry will leave a film about the thickness of thin writing paper, and dry in the dark.

3. When dry, expose under a negative for about three hours, or until all details of the picture are fully visible when viewed by transmitted light

4. After exposure, immerse in clean cold water until those portions of the film acted upon by light filtered through the negative become granulated or reticulated; the plate is then removed from the water, drained, and remainder of moisture removed by blotting-paper.

5. A mould is now taken from the film in gutta percha or sulphur, and from this mould a block is made by electrotyping or stereotyping.

Mr. Ryley in *Photograph News*, June 27th, 1884, says:—

1. Dissolve 1 ounce of Coignet's Gelatine in 3 ounces of distilled water, and to 1 ounce of this solution, add 30 grains of Nitrate of Silver, previously dissolved in $\frac{1}{2}$ ounce of distilled water ; to the other, 2 ounces of gelatine solution, add 2 ounces of a saturated solution of Bichromate of Potass, and while warm, add to it the Nitrate of Silver and mix well.

2. Level a glass plate and pour over it as much of the above solution as will, when quite dry, form a film about the thickness of thin writing paper.

3. Now expose the plate to sunlight under a glass positive for about three hours, or until all the details of the picture appear when viewed by transmitted light.

4. Then wash it under water until those parts of the picture which are the least acted on by light become granulated, which is caused by a peculiar contraction of the film ; the superfluous moisture must then be removed by blotting-paper.

5. A negative may be used instead of a positive, but the exposure will not be more than half the time, and the result will still be a positive, and the grain of your film will be much finer. And in this granulation lies the whole secret of the process ; and yet, strange to say, not one word can be found respecting it in the specification, and therefore I contend that all patent right is justly forfeited.

6. A mould in gutta-percha is then taken from the film and rendered conductive by plumbago or other means, and put into the electrotype apparatus until you have a deposit of copper of sufficient thickness to form a matrix, from which you can deposit a thick copper plate strong enough to print from.

BYE-THE-BYE.

Photographic News, December 2nd. 1881.

ABOUT PHOTO-LITHOGRAPHY.

THE whole process of photo-lithography bids fair to be revolutionised by the introduction of the velvet roller, an innovation we owe, as already mentioned in these columns, to the

Austrian Geographical Institute in Vienna. Several establishments, both private and government undertakings, have already adapted the new form of roller, and Major Waterhouse, B.S.C., the Deputy-Surveyor-General of India, was so pleased with its working that he suggested some experiments with rollers made up with other similar materials. Of these experiments, as also of the velvet roller in general, it is our intention to say a few words.

But, first of all, on the subject of photo-lithography generally, we must utter a word of warning. Only those who are competent lithographers can succeed in photo-lithography. And, indeed, this is only to be expected. Lithography is of itself a delicate art, and photo-lithography is more delicate still. A lithographer has already much to learn when he begins, so that he knows nothing of that art had best leave photo-lithography alone. Only when he has a competent lithographer to assist him should a photographer engage in the art of photo-lithography.

But in these circumstances, he will find that with the assistance of the velvet roller he will rapidly go ahead. The treatment of the sensitized paper we need not here describe in detail, since the reader cannot do better than refer back to Mr. Butter's paper on the subject published in the *News* of March 19, 1880. Suffice it to say that the paper chosen must be good bank-post, without any ribs—since ribbed paper is not smooth and tough—and that there must be no alum put into the bichromated gelatine bath upon which this paper is floated. Alum makes the surface hard, and with the velvet roller this may be as delicate as possible without sustaining injury.

We will suppose the bank-post paper floated upon the bichromated-gelatine and dried. It is put under a line negative—nothing is better for intensifying than the lead formula of Eder and Toth—and printed. The lines of the design can be seen upon the yellow print if you look for them, and they become yet more visible when the impression is put into cold water. It remains immersed for four or five minutes, and is then laid carefully and flat upon a glass plate, which must be a little shorter than the print. Excess of moisture is removed by means of blotting-

paper, and the print is now carried off to the lithographic room. The photographer puts the print down in front of him, upon a press or other convenient position for rolling. A stone slab about the size of the glass plate is convenient for resting the print on. The edge of the print nearest him he tucks under the glass plate ; the end away from him is loose, so that when it comes to the rolling, by always rolling away from him, he presses the print down, while it yet has a tendency to flatten out and not cockle. Drawing back the roller under these circumstances would, of course, be fatal.

The velvet roller charged with ink is taken in hand and lightly passed over the print. The rolling is only done one way—away from the printer, as we have explained. The roller is but half the weight of an ordinary litho-roller, and—no pressure or scarcely any—is exerted by the printer. It is hardly like inking a lithographic surface. The moisture over the surface of the impression repels the ink, it is true, but the lines of the drawing or design stand up so prominently that they remind one almost of relief printing. The delicacy of the lines as they gradually take up the black ink reminds one of bank-note engraving, they are so exquisitely sharp and fine, and the lithographer who for the first time undertakes the work is fairly charmed with its beauty. He scarcely knows how he has produced such exquisite work.

There must not be too much ink applied to the print, for the simple reason that this will subsequently be pressed out of shape by the lithographic press, and then the lines get blurred and ragged. A skilful photo-lithographer requires to pass the velvet roller but half-a-dozen times over a gelatine impression—supposing this has been properly exposed—to produce a perfect print or transfer.

The ink used has been transfer ink, so that nothing now remains but to go on with the lithographic work. A polished litho-stone is warmed, the inked-up print is laid face downwards upon it, and then passed through the press. The result is, that the inked impression is transferred to stone, and thence, of course, any number of impressions may be pulled in the ordinary fashion.

To come back to the velvet roller. It needs very careful construction, if it is to answer well. In the first place, it must be light. Velvet stretched and sewn like leather over an ordinary wooden roller will not answer. There must be either less wood, or the velvet, as Major Waterhouse prefers, may be fitted to a tin stock. In any case, the roller should not be more than half the ordinary weight. Nor must the velvet be sewn in the usual way with a double thickness at the join, but carefully drawn together with stitches. If there is a join, then the roller fails to grip at this part, and the print at this spot not only lacks ink, but is frequently unclean.

Next to lightness, the roller should be of soft consistence, or "puddingy," to use an expressive phrase of a photo-lithographer friend. To ensure this, there should be a flannel under-cover, no less than three rolls of thick flannel, or so-called collar-cloth, being put round the wood or tin stock. The velvet itself soon becomes incorporated in the "puddingy" mass, and especially if it happens to be cotton velvet or velveteen. And here we may mention that the result of experiments with Major Waterhouse's three rollers was to the effect that their value is in the following order, viz. :—

1. Cotton Velvet.
2. Silk Velvet.
3. Moleskin.

A "puddingy" nature and "pulling power," when rolling, are the requirements of the velvet roller, and these are best secured by cotton velvet with the underfolds we have specified. The gelatine impression, during the rolling, is treated precisely as a lithographic stone, and may be wetted with a sponge or rag, as occasion requires.

Of course it is impossible to *scrape* the ink from the velvet roller. The best way to preserve the roller is to put it into a bag after use, without any further manipulation whatever; then before beginning work again, free the roller from the old ink by rolling it on a clean slab, cleaning the slab at intervals with

turpentine of the old ink. The velvet roller should always be cleaned in this way before using.

There is one important point, and that is the mixing of the transfer ink for application to the slab and to the roller. So that these instructions may be as practical as possible, we append here the directions of a practical photo-lithographer on the subject :—

Take two ounces of transfer ink from the pot, add $\frac{1}{4}$ -ounce of olive oil, mix well together with the muller on a slab ; this you will find gives a paste about the consistency of butter. Such paste makes capital stock. When the printer is ready to roll up the transfer, reduce the above with turpentine to the thickness of cream ; you will now find your ink is ready for the roller. Charge the roller liberally, and roll the roller well up on the slab. In so doing, you will find the turpentine evaporate, leaving the ink in beautiful condition for a first-class transfer.

Should you find your ink get too stiff, reduce it with turpentine ; be sure you roll your transfer one way only, namely, from you.

If the above directions be carefully carried out, you will be able to wet and roll-up the transfer the same as you would a lithographic stone.

SILVERING THE GLASS MIRRORS.

From the Photographic News. April 10th 1885.

FOR silvering the glass, one cannot do better than to quote the directions for working Common's process given by Major Waterhouse in a previous volume of the PHOTOGRAPHIC NEWS.

"The solutions recommended by Mr. Common are three—

(1)	Nitrate of silver...	...	...	...	1 ounce
	Distilled water ...	...	...	...	10 ounces
(2)	Caustic potash ...	...	...	...	1 ounce
	Distilled water ...	...	...	...	10 ounces
(3)	Glucose ...	...	...	...	$\frac{1}{2}$ ounce
	Distilled water ...	...	...	...	10 ounces

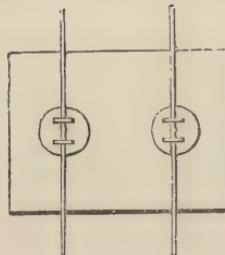
The above quantities are sufficient for 250 square inches ; consequently an ordinary copying mirror 8 by 6 would require rather more than 2 ounces of each solution, and other sizes in proportion.

The caustic potash and distilled water must be quite pure Ordinary caustic potash will not answer at all. The best to use is known as *pure by alcohol*.

The glass surface to be silvered is carefully cleaned with strong nitric acid, applied, as recommended by Mr. Browning, with a Buckle's brush, then well washed in clean water, and after rinsing with distilled water, laid, face downwards, in a dish of distilled water till wanted.

Before cleaning the glass, it will be necessary to arrange for supporting it face downwards in the depositing dish, so that the surface to be silvered may be quite horizontal, and just below the level of the fluid, which should be about half an inch above the bottom of the dish.

I have generally used a large cork, about four inches in diameter, cemented to the back of the plate, and fitted with three strings, by which it could be suspended in a level position and adjusted to any height by winding the string over a roller placed at a convenient height above the dish. As this arrangement was not available, I fixed on the back of the plate two ordinary wide-mouthed bottle corks of equal thickness in the positions shown in the figure, and to these corks attached thin slips of bamboo running transversely across the plate, and of sufficient length to rest on the sides of the dish, thus:—



The slips of bamboo gave the arrangement a certain amount of spring, by which the height of the plate could easily be regulated by putting on weights till the surface of the plate was just below the level of the fluid in the dish.

To prepare the silvering solution. A sufficient quantity of the silver solution, No. 1 (2 ounces), is put into a perfectly clean glass. Ammonia is dropped in till the precipitate first formed is just re-dissolved. The same quantity of potash solution, No. 2, as of silver is now mixed in, and the precipitate again dissolved by ammonia. A little more silver solution is then added to produce a distinct turbidity, and distilled water to make up the quantity necessary to fill the depositing dish to about three-eights or half an inch, and the mixture is then filtered through cotton into another clean glass vessel.

The same quantity (two ounces) of filtered solution of glucose, No. 3, as was taken of silver and potash, is now mixed in, and the whole poured into a depositing-dish (which should preferably be of glass, well cleaned with nitric acid).

The glass plate is then taken out of the distilled water and laid face downwards on the silvering solution, being supported, as before described, just above the surface, so that the solution does not cover its back.

Mr. Common places the requisite quantity of distilled water in the dish, in which the mirror has been remaining face downwards, and then, having lifted the mirror up, pours in the undiluted silvering solution, together with the glucose solution, stirs well together, and then carefully lowers the mirror again into the dish.

Almost immediately after the immersion of the plate, the silvering action begins, and, if things are going on well, a brilliant reflecting surface will be seen at the back of the plate and in forty minutes, or even less, a good deposit of silver will be obtained. It is usually recommended to stop the action as soon as the silvering fluid appears clear and free from turbidity, but it is not always easy, I find, to see this.

After silvering, the plate is thoroughly well washed, finishing with distilled water, and dried off quickly. A slight cloudiness of the surface may appear, and must be removed by polishing before the mirror can be used. It is better to allow the mirror to remain a day or so before polishing, in order to harden the coating.

To polish the plate, it should be slightly warmed, and perfectly dry, and rubbed very gently in small circles with a piece of very soft and dry chamois leather, afterwards using a little jewellers' rouge.

Mirrors should always be kept in a dry place, and will require re-polishing from time to time.

RECENT IMPROVEMENTS IN THE ASPHALT PROCESS.

From "Photographic News," July 3rd, 1885.

PROFESSOR J. HUSNIK has recently worked out an improvement which forms a genuine advance in the asphalt process as applied to photo-zincography. This he describes in the *Photographische Mittheilungen*, from which we abstract the following particulars of the process.

In working the asphalt process it is desirable to separate from the bitumen the portion which is soluble in ether, that portion being insensitive to light. To bring this about it has been customary to powder the bitumen, to pass it through a fine seive, and to pour ether over it.

This process has been only partially successful, a considerable quantity of the insensitive bitumen remaining undissolved after any reasonable time of the action of the ether.

Herr Husnik gets over the difficulty in the following ingenious manner. The bitumen is reduced to a coarse powder, and is dissolved in rectified turpentine. By allowing sufficient time a very large proportion of the bitumen may be thus dissolved.

Herr Husnik states that with occasional stirring during three days the turpentine can be caused to take up one-third of its weight of bitumen. When a saturated solution of bitumen in turpentine has been made, the liquid is diluted with ether. This process now precisely corresponds with the precipitation of a gelatine emulsion by the use of alcohol, except that in the latter case it is usual to pour the emulsion into the alcohol ; that is to say, into the precipitating fluid ; whilst, in the case of the bitumen process the solution, corresponding to the emulsion, has the precipitating fluid the ether poured into it. The reason for adopting this course will soon be made evident.

As ether is poured into the solution of bitumen in turpentine, the first effect is merely to cause the fluid to become less viscous ; but after the solution has been about three times diluted a doughy precipitate is thrown down.

To discover now whether the ether has thrown down all the insoluble asphalt, a portion of the upper stratum of the liquid is placed in a small vessel. If an addition of ether to this small portion of the liquid causes the precipitation of any bitumen, it shows that sufficient ether has not been added to the turpentine solution. Further additions are made, a test being performed after each, as just indicated, till no further precipitate takes place.

It will now be evident why the ether is poured into the bitumen solution, and not *vice versa*. It enables the quantity of ether necessary to be accurately gauged, so that there is no waste.

The solution is allowed to stand for twenty-four hours, when the supernatent fluid is poured away. The precipitate which remains behind amounts to about half the original bitumen. Fresh ether is poured over the precipitate, which is occasionally stirred up during two or three days. This causes it to become considerably firmer, on account of the removal of almost the last trace of the turpentine, and also of the last of the bitumen soluble in ether.

The last portion of ether is retained to be used again. The precipitate is removed with a bent strip of zinc from the vessel in which it was thrown down ; it is placed in a porcelain dish, and is

allowed to remain in a warm place for several days, with occasional stirring to secure the complete removal of the ether, when there remains a "hard, extremely brittle, glittering black mass, which is readily reduced to powder by hand." After the bitumen has been thoroughly freed from ether, as described, it is dissolved in benzol (not benzine) free from water. Then is added to each 100 parts of the bitumen $1\frac{1}{2}$ parts of Venice turpentine. This renders the film more pliable, and less liable to scale off than it would be without the addition.

If, as is common with commercial benzol, there is a trace of water, the solution of bitumen cannot be caused to flow evenly over the zinc plate, but runs into lines and drops. This defect can be overcome by a free addition of chloroform.

With films made from bitumen prepared as described, the exposure necessary with a clear negative is only ten minutes in bright sunshine, or one or two hours in diffused light, and development is complete in four minutes.

THE VELVET ROLLER AND COLLOTYPE FOR AMATEURS.

BY SAMUEL C. RILEY.

In using the velvet roller no particular precautions are needed, but the roller should carry enough ink of moderate thickness, consisting of pure olive oil and litho-transfer ink thoroughly incorporated. The greatest advantages accrue from first rolling the collotype plate with the velvet roller, covering the whole plate with a thin uniform coating, and immediately rolling the plate with a leather roller sparingly covered with the same ink as used on the velvet roller. Any amount of brilliancy can thus be obtained (providing the negative is perfect), always remembering that a little sharp rolling clears the whites effectively. I have repeatedly seen collotype plates that could not be inked up with the leather roller by itself (owing to the plates being dried badly), which gave perfect impressions after having been inked lightly

all over with the velvet roller, the plate being cleared with a few gentle rolls with the leather roller.

To make a collotype plate that will give perfect impressions, proceed as follows :—

First, the substratum for the plate.—Take one ounce of ordinary dinner ale, 6 or 8 drops of silicate of soda, and well shake into a froth in a bottle, stand it by for twenty minutes, then filter. Take a clean glass plate (patent plate is best), and with a camels' hair brush go over one side of the plate ; set on end to dry. When dry go over the plate again, letting it dry this time the other way up. When again dry, let a gentle stream run on it for thirty seconds ; then again dry on end. When again dry, you may coat with the following solution :—44 grains Nelson's ordinary gelatine soaked for quarter of an hour in cold water, then heated in the oven till all is melted. Then pour into it the following hot solution :—

Water	...	...	...	...	$\frac{1}{2}$ ounce
Bichromate of ammonium				...	6 grains

Well mix and filter. On no account let the solution get to boiling point. Take an 8 by 5 plate with the dried substratum on it, and flow over it $\frac{1}{2}$ an ounce of the hot gelatine solution ; place at once on the levelled glass in the drying box. It should dry in two hours, and is ready for instant use. Expose under an ordinary negative for an hour, then wash in cold water for $1\frac{1}{2}$ hours, and dry in the open air, which takes from four to six hours, according to the weather. When dry, damp with very weak glycerine and water, allow the moisture to slightly evaporate, roll as above mentioned, and take impression off at once.

The drying box is as under :—20 inches high, 12 inches square the levelling glass about six inches from the top of the box, three sheets of loose blotting-paper lying on it for the plate to rest on, a piece of iron (say) 6 by 4 by 3, heated in the fire, and placed 6 inches under the levelling glass. There should be at least three or four holes at the bottom sides of the box, and three at the top, to promote a good draught. The heat in the box should be about 120° F.

PHOTOGRAPHY AND THE NEWSPAPER.

BY S. H. HORGAN.

Extract from "Photographic News," July 4th, 1884.

To give you an idea of the varied uses of photography on a newspaper, we will classify the different kinds of illustrations. There are, first, portraits ; second, landscapes—views of all kinds ; third, news events ; fourth, cartoons and the various ideal pictures ; fifth, maps and mechanical drawings.

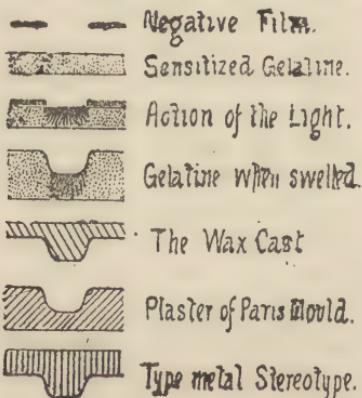
I have many examples of such a process as is now used in the illustrated press of to-day, and the difficulty to its more general adoption will be found in the fact that very rarely will a subject be photographed with the composition, arrangement, light, and shade, of a quality possessing sufficient "spirit" for publication in *facsimile*.

At present all photographs are altered to a greater or less extent before presentation in the newspaper. This is done after the subject is photographed the second time. We have seen how photography brings the matter to the editor's hands. Now we come to the second use of photography. The photograph is now either photographed on wood, or an untoned photographic print is made on plain paper. On this latter an artist traces the design with a pen and india ink, and here the alterations are made ; if a view, the artist introduces figures, alters the light and shade, and sometimes changes the composition. When he has obtained all the assistance he requires from the photograph, he bleaches it away by pouring over the photographic print, on which is the india-ink drawing, a solution of bichloride of mercury in alcohol. This leaves his drawing on perfectly white paper.

Now, in the case of the photograph on wood, the addition of figures, and the other changes I have spoken of, are made over the photograph-covered wood block before it passes to the engravers, where it is changed still more. In the case of a wood engraving photography is used but twice, ending with the placing

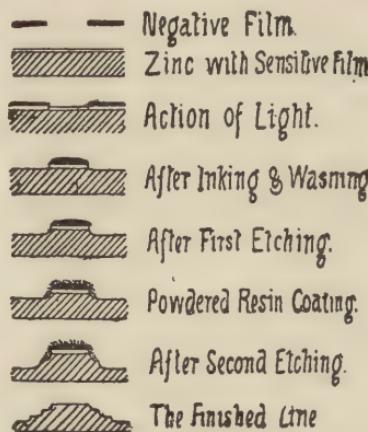
of the subject on the wood ; so we will dismiss it. But, with the india-ink drawing on paper, photography must again be used to produce a printing block. The various processes for accomplishing this are innumerable, but they can be classed under three heads—First, what is called the etching method ; second, the photo-relief plate method ; third, the photo-electrotype. Of the three, each has its advantages. The first, or the “etching method,” give a plate of zinc usually, in which the whitest or hollow portions of the plate have been dissolved by an acid ; the second or photo-relief plate method, produces a printing plate in stereotype metal ; and the third yields an electrotype. All three depend on the rendering insoluble of gelatine or albumen when in combination with a bichromate, either of potash or ammonia, when it is exposed to light. The peculiarities of the resulting plate I will state briefly. The zinc etching method produces the most artistic result, but it is not sufficiently mechanical in its manufacture to ever be much used here. It necessitates the personal attention of a man with artistic judgment throughout the whole process of the etching. In Europe, where artistic labour is poorly paid, they can afford to work this process successfully.

I will illustrate the difference between the three processes for newspaper work by diagrams on the blackboard, showing a section



of line, and the steps taken in each process towards its production.

The above shows the several stages in the photo-relief method. First the negative film is brought in contact with the sensitized gelatine, when the latter is exposed to light, after which the gelatine, which has been so exposed, is placed in a tray of



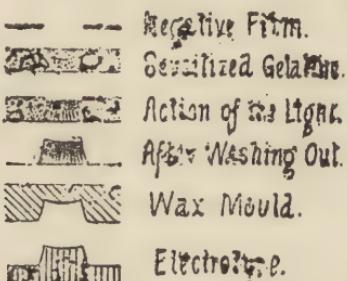
water. The portions unhardened swell ; then a cast is taken in a waxy composition, from which is made a plaster of Paris mould, in which to cast a type-metal stereotype, the peculiarity of the resulting line being that the corners of the line are slightly rounded. For book and magazine printing, where the press cylinder turns perfectly true, and time can be given to the process of overlaying, in the hands of an artistic printer this line with the rounded face can be taken advantage of to produce a light or heavy line, according to the pressure of the paper on it during the operation of printing.

With the photo-electrotype line, which is produced by the action of light on a sheet of sensitized gelatine, as in the photo-relief process, the unhardened gelatine is washed out with a soft brush and a tepid solution, leaving the portions acted on by the light in relief. From this an electrotype is made in the usual way.

The face of the line produced by this process is the reverse of the photo-relief line—that is, it is concave where the other is convex, the corners being sharp and highest where the wear is

greatest. This makes the most serviceable plate for newspaper work, giving a square honest line at each impression.

The above diagrams illustrate the various steps of the zinc-etching process. A plate of zinc is coated with a film of albumen sensitized with bichromate of ammonia. After the exposure to light, the plate is rolled with a fatty ink, then the unhardened albumen film is washed away, leaving the ink only on the lines,



protecting them from the action of the acid in which the zinc plate is immersed. After a slight etching, the plate is removed from the acid and dried, then powdered dragon's-blood is brushed against the sides of the line. The zinc plate is heated, the powdered dragon's-blood combines and forms a resinous coating, which protects the sides of the line from the further action of the acid. This process of drying, dusting with the powder, heating, and etching, is repeated many times, till the requisite relief is obtained, the finishing line showing, as in the diagram, a series of steps down the side corresponding to the number of etchings.

The finest illustrated newspaper in the world prefers the plate produced by this process ; but, as stated, it cannot compete in this country with its more mechanical rivals.

EXTRACTS FROM "PHOTOGRAPHIC NEWS,"

March 31st, May 5th and June 30th.

I.—MORDANTS FOR STEEL.

NITRIC ACID forms the basis of most fluids for etching steel as well as for other metals. Acetic acid and alcohol are some-

times added, and some formulæ contain nitrate of silver, corrosive sublimate, salts of copper, &c. Iodine is also a most efficient mordant for steel, and Mr. Fox Talbot used the chlorides of iron and platinum for etching his plates through the coating of bi-chromated gelatine.

Plain Acid Mordant.

Kruger.—First biting—

Muriatic or nitric acid	...	...	1 part
Water	...	...	8 parts

Stronger.

Acid	...	...	...	...	1 part
Water	...	...	...	...	4 parts

Deepest.

Equal parts acid and water.

Kruger.—*Chromic acid*, diluted according to the effect to be produced. This also serves for zinc, copper, and brass, and bites } with great ease and certainty, making a good vertical cut.

Ed. Turrell.—

Glacial acetic acid	...	...	...	4 parts
Absolute alcohol	...	...	...	1 part
Nitric acid, sp. g. 1·28	...	...	...	1 „

The acetic acid and alcohol are mixed and allowed to stand for half-an-hour, then the nitric acid is added very gradually. This mordant is applied from 1 to 15 minutes, according to the strength desired, and may be strengthened by adding nitric acid.

Etching Solutions with Alcohol.

Alcohol seems to be added with the object of softening the action in the first biting, and of making the mordant bite at once. For etching Niepce de St. Vietor's asphaltum plates M. Lemaitre used, for the first biting—

Nitric acid, at 36°	...	...	...	1 part
Distilled water	...	...	...	8 parts
Alcohol, at 36°	...	...	...	2 „

And finished off with nitric acid and water, without alcohol.

Etching Solution with Nitrate of Silver.

Alcohol ...	...	...	...	...	6 parts
Distilled water ...	...	...	...	9 "	
Pure nitric acid	...	...	...	16·6	
Nitrate of silver	...	...	...	0·83	

The liquid improves by keeping. Before beginning, wash the plate for a few seconds with dilute nitric acid (at 4 per cent.), then apply the above mordant for about three minutes, and wash off with distilled water containing 6 per cent. of alcohol. Repeat the biting as often as may be necessary, well washing between each operation.

Deleschamps.—Glyphogen.

Acetate of silver	...	...	...	8 parts	
Rectified spirit	...	...	...	500 "	
Distilled water ...	...	...	...	500 "	
Pure nitric acid	...	...	...	260 "	
Nitric ether	...	...	...	64 "	
Oxalic acid	...	...	...	4 "	

This is recommended as being free from the defects of many of the other mordants, and giving a clean vertical bite. Several formulæ contain salts of copper.

Roret.—

Nitric acid	...	...	...	...	62 parts
Distilled water	...	...	...	...	125 "
Alcohol ...	...	...	...	...	187 parts
Nitrate of copper	...	...	...	...	8 "

Iodine is recommended as a very efficient mordant for steel, being free from the inconveniences caused by disengagement of gas, as when biting with nitric acid. Messrs. Schwarz and Boehme give the following:—

Iodine	...	...	...	...	2 parts
Iodide of potassium	...	...	...	...	5 "
Water	...	...	...	...	40 "

This may be further diluted up to 40 parts more water for etching the finest lines. It gives good deep lines, sharp, and with clear

edges even, for the finest and closely-ruled lines have no tendency to run one into the other.

The following resembles the etching fluid for copper, commonly known as "Dutch Mordant."

Cooley.—

Hydrochloric acid	...	...	...	5 parts
Water	...	...	...	95 ,,
<i>Mix and add</i> —				
Chlorate of potash	...	...	...	1 part
Water	...	...	...	50 parts

Cooley.—For electric etching with the battery, a solution of common salt is used.

II.—MORDANTS FOR COPPER.

The most useful mordants for copper are nitric and nitrous acids, more or less diluted with water. Latterly, however, a mixture of chlorate of potash and hydrochloric acid, known as the "Dutch mordant," has come more into use. For some purposes, perchloride of iron in solution is a useful mordant, particularly in photographic work with gelatine films. These two latter mordants bite more quietly than the acids, so that the lines are not so much enlarged, and there is not the same risk of close lines running together and other inconveniences caused by the evolution of bubbles of gas.

Acid Mordants.—Lalanne.

Nitric Acid at 40	...	...	...	1 part.
Water	...	...	...	1 ,,

With a little old etching solution added, or pieces of scrap copper.

Malaret.

Nitric or sulphuric acid	...	...	...	1 part.
Saturated solution of bichromate of potash			2	“
Water	...	...	...	5 ,,”

Fizeau used for Daguerreotype etching, a mordant composed of nitric, nitrous, and hydrochloric acids.

Dutch Mordant.

Fuming muriatic acid (sp. g. 1.190)	...	10 parts.
Water	...	70 "
To this will be added a boiling solution of		
Chlorate of potash	...	2 parts.
Water	...	20 "

This may be diluted with from 100 to 400 parts of water as required.

Ferric Chloride

Perchloride of iron, more or less diluted in water, is according to Hamerton, an excellent mordant. It bites deep and clear, without enlarging the line much, and there is no ebullition, as with nitric acid. It is particularly useful in photographic etching through gelatine, as the latter is insoluble in it.

In most cases the mordant is flowed over the plate, or kept moving on it in the same way as a photographic developer. Such mordants are generally used for finishing off and deepening the light tints, and are called *eau fortis à couler* or *à passer*. The following formulæ are given :—

Roret :—Abraham Rosse's.

Strong white or distilled vinegar	...	3 litres.
Sal ammonia	...	180 grammes.
Common salt	...	180 "
Pure verdigris	...	120 ",

A little oxalic acid is sometimes added. The solids are ground up, and boiled in the vinegar. Acetic acid at 3°, or pyroligneous acid, may be used in place of vinegar, and, if too strong, more vinegar should be added.

The following used by Callot and Piranesi, is similar, and prepared in the same way :—

Strong vinegar	...	...	...	...	8 parts
Verdigris	...	...	...	...	4 ",
Sal ammoniac	...	...	...	...	4 ",
Salt	...	...	...	...	4 ",
Alum	...	...	...	...	1 part
Water	...	...	...	...	16 parts

For relief etching use only 10 parts of water.

Relief Etching.

For etching copper in relief, the following glyphogen is recommended by Deleschamps :—

Nitrous acid at 30°	...	...	...	2 ounces
Acetate of silver	...	...	...	6 drachms
Hydrated nitric ether	...	...	...	16 ounces

The nitric ether is prepared by mixing two ounces each of nitric acid and alcohol, and when the reaction commences, stopping it by adding eight ounces of distilled water.

Tint Etching.

Flowers of sulphur mixed with oil forms a good composition for etching tints. It can be applied with a brush. For a flat tint, Hamerton says “Oil the plate liberally with olive oil, and blow flour of sulphur upon this. The sulphur if allowed to remain on the plate, will produce a flat tint, more or less deep in proportion to the time it remains.

Roret gives the following formula for tint etching :—

Bay salt	...	...	...	...	2 parts
Sal ammonia	...	...	...	...	1 „
Verdigris	...	...	...	...	1 part

These are pounded together, and the mixture kept in a bottle.

When required for use grind up a little in a glass with some syrup of old honey, so as to make a mixture which flows readily, and may be used with a brush like a colour. It is used after the bitings of aquatint plates with acid, to give finish and vary the tints.

Fielding (for aquatint).

Nitrous acid	...	...	...	...	1 part
Water	...	...	...	...	5 parts

For the strongest touches, nitrous acid and water, equal parts, applied with a feather or brush. No. 19 may also be used for this purpose, either with or without a little gum.

Hamman.—Dilute nitric acid at 12° (sp. g. 1.09), mixed with—

Distilled water ...	...	...	...	12 parts
Alcohol ...	...	...	...	3 „

This is said to give a grain in biting, so that the ordinary grained ground may be dispensed with.

Electric Etching.

It has frequently been proposed to etch by means of electricity, and in some cases it may be an advantage to do so.

The copper plate to be engraved is attached to the positive pole of a suitable battery and placed as anode in a solution of sulphate of copper, or in water acidulated with sulphuric acid.

If suitable cases, different degrees of depth may be given, putting parts of the anode and cathode nearer together or further apart.

Grove etched Daguerreotype plates with a single pair Grove or Bunsen cells, by inserting the plate to be etched, and a platinum plate of the same size, in a wooden frame having two grooves a quarter of an inch apart.

The Daguerreotype having been attached to the battery as anode, and the platinum plates as cathode, the frame is immersed in a suitable vessel filled with

Hydrochloric acid	...	...	..	2 parts
Distilled water ...	...	...	...	1 part

Contact is made for about half a minute, after which the plate is removed from the acid, washed thoroughly with distilled water, then placed in a solution of hyposulphite of soda or ammonia, and the deposit removed from the surface with gentle rubbing with cotton. It is then again rinsed with distilled water and dried.

MORDANTS FOR ZINC.

The comparative cheapness of zinc would give it an advantage over copper or steel for engraving and etching with the graver or point, but it does not seem to be recommended for these purposes. It is hard to cut with the graver, and, though it bites easily, it is not suitable for fine work. Another defect is that it will not stand a long impression ; but this may be overcome by

surfacing the plate with copper. The principal uses of this metal for printing purposes are for surface printing or zincography in the same manner as lithography, and for the process of biting in relief, and zincotyping or Gillotage, now so largely employed as a substitute for wood blocks. It can also be engraved very delicately in the same style as engraving is done on stone through a coating of gum.

The etching fluids for zinc are of two entirely different kinds : first, mixtures of gum and weak acids used for preparing plates for zincographic printing in the lithographic press, or for preliminary inking preparatory to being bitten in relief by the Gillotage process ; and secondly, mineral acid, more or less dilute, used for biting in relief and ordinary etching.

Zincographic Etching.

This kind of etching is more a preparation of the plate for printing than engraving or biting, the object being merely to fill up the pores of the metal with gum, and prevent it receiving printers' ink from the roller elsewhere than on the lines of the drawing.

The solution most commonly employed for this purpose is the mixture of gum and decoction of galls, in use at the Ordance Survey Office, Southampton, and given by Sir Henry James in his work on *Photozincography*. It is prepared as follows :—4 ounces of Aleppo galls are bruised and steeped in 3 quarts of cold water for twenty-four hours ; the water and galls are then boiled up together, and the decoction strained. The gum-water should be about the consistency of cream. One quart of the decoction of galls is added to 3 quarts of the gum-water and to the mixture is added about 3 ounces of phosphoric acid, which is prepared by placing sticks of phosphorus in a loosely corked bottle of water, so that the ends of the sticks may be uncovered. The oxidation of the phosphorus produces phosphoric acid, which dissolves as fast as it is formed.

The etching solution should only just mark a piece of plain zinc.

In Richmond's *Grammar of Lithography* the following modifications of this formula are given :—

Decoction of nutgalls	...	...	$\frac{3}{4}$	pint
Gum water as thick as cream	...	...	$\frac{1}{4}$	"
Phosphoric acid solution	...	...	3	drachms

Boil $1\frac{1}{4}$ ounces of bruised nut-galls in $1\frac{1}{4}$ pounds of water till reduced to one-third, strain, and add 2 drachms of nitric acid and 4 drops of acetic acid.

Richmond recommends, however, the use of simple decoction of galls without acid, and gumming in after etching.

Scamoni has the following, by Garnier—Boil about $1\frac{1}{4}$ ounces of bruised gall-nuts in a pint of water, till reduced to one-third, filter, and add two drops of nitric acid, and three to four drops of muriatic acid. For very fine work this may be weakened with water. It is applied for about a minute, then washed off, and the plate gummed.

Zincotypographic Etching.

In biting zinc plates in relief, the acid generally used is nitric of different degrees of strength, according to the nature and state of the work.

After the transfer is made, the plate is etched with one of the foregoing preparations, then inked in and dusted with finely-powdered resin, which adheres only to the lines. This procedure is followed after every biting, the plate being warmed to melt the resin and inky coating, so that it may run down between the lines and protect them from the undercutting action of the acid.

Kruger, in his *Die Zinkogravure*, recommends, for the first relief etching, nitric acid 30 to 40 drops to 100 grammes of water, applied for five minutes. For each subsequent etching, 8 to 10 drops of acid are added for each 100 grammes of water, and the

time is increased, by degrees, from five to fifteen minutes. For the final etching of the broad lights he uses—

Muriatic acid	...	...	...	...	4 parts
Nitric acid	...	...	...	...	1 part
Water	...	...	...	...	16 parts

To soften down the ridges between the lines the plate is inked and dusted as before, and etched with dilute nitric acid at 5 per cent., applied for a minute, and the inking, dusting, and etching repeated as often as may be necessary.





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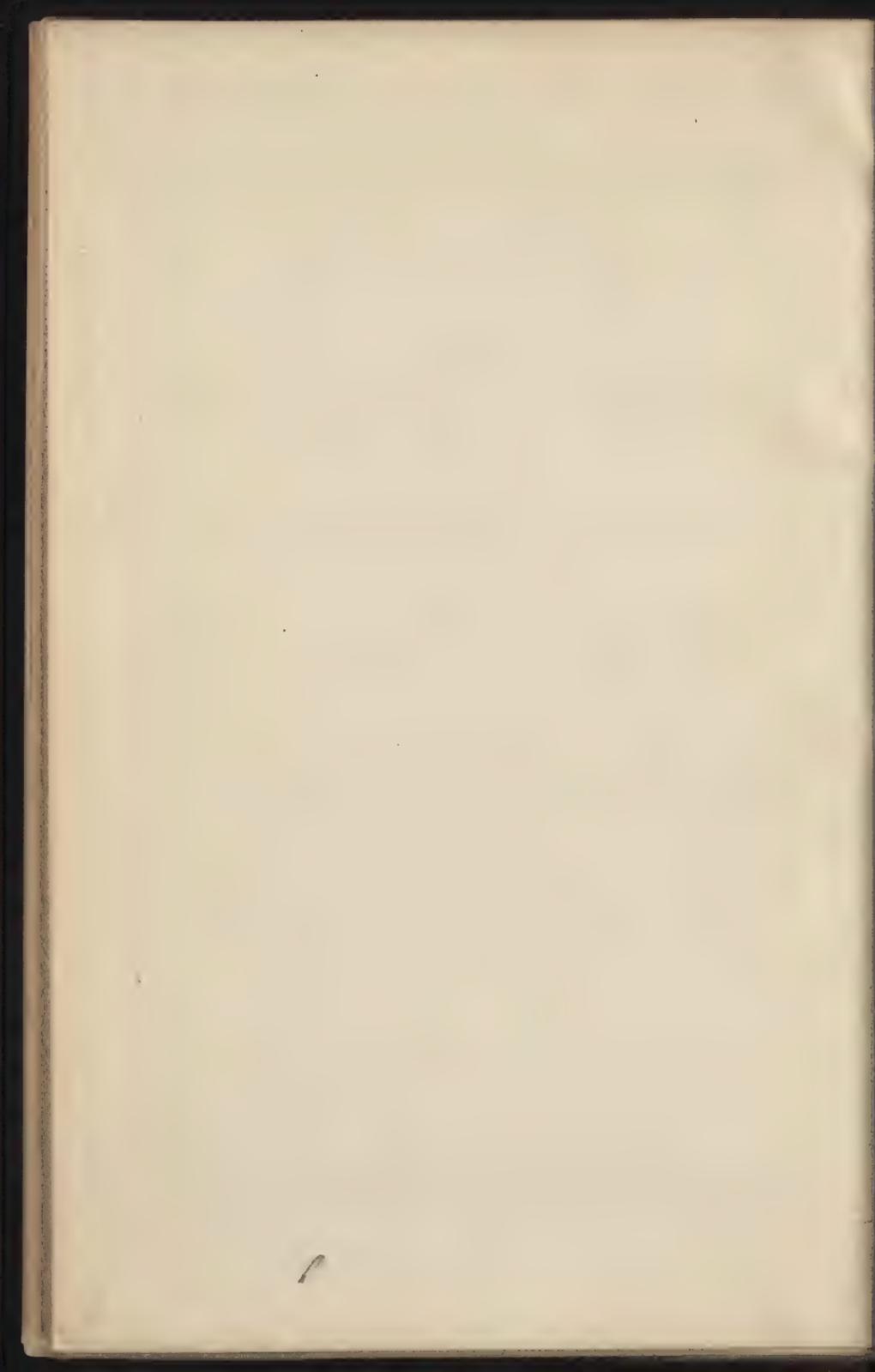
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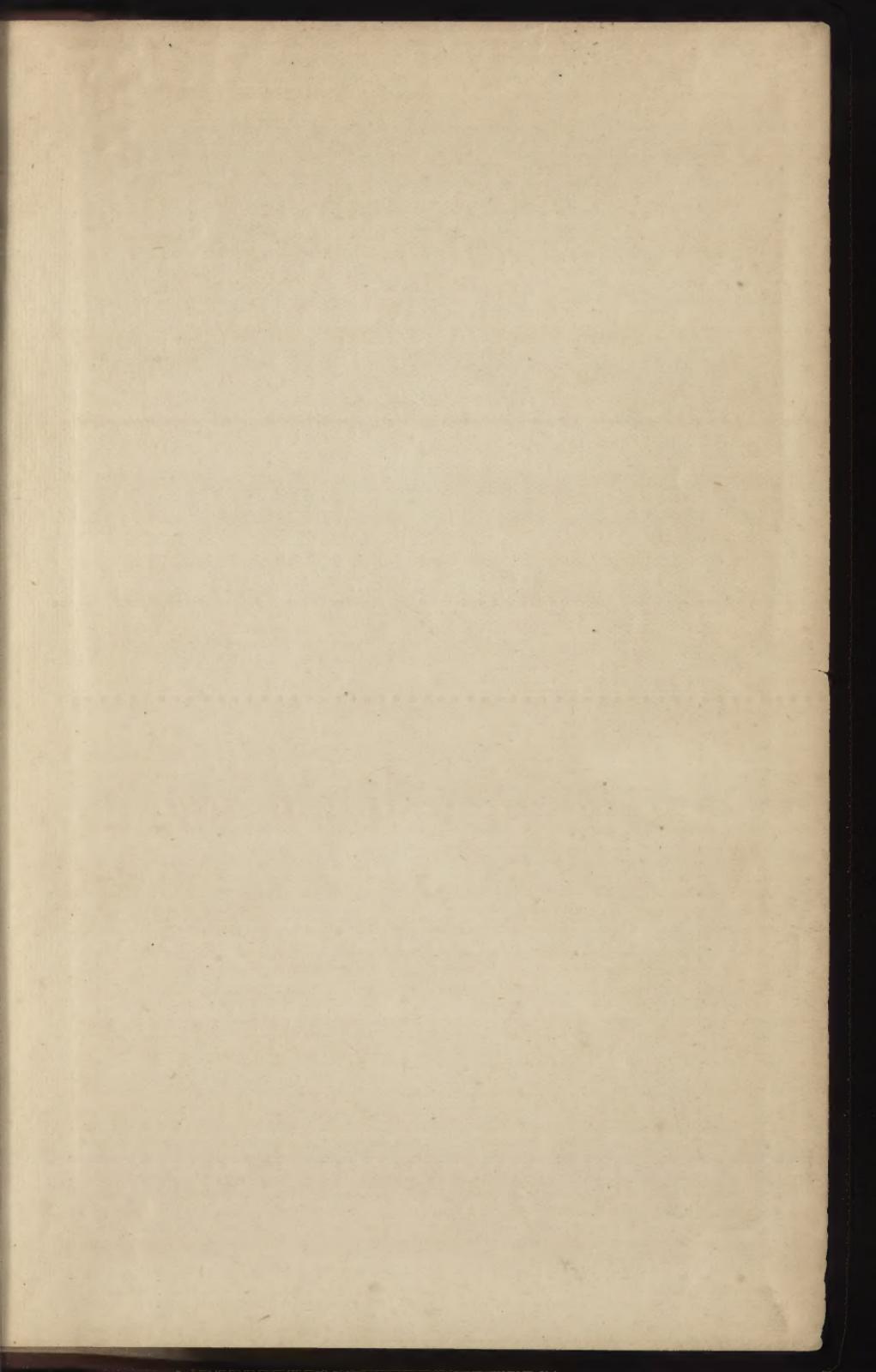
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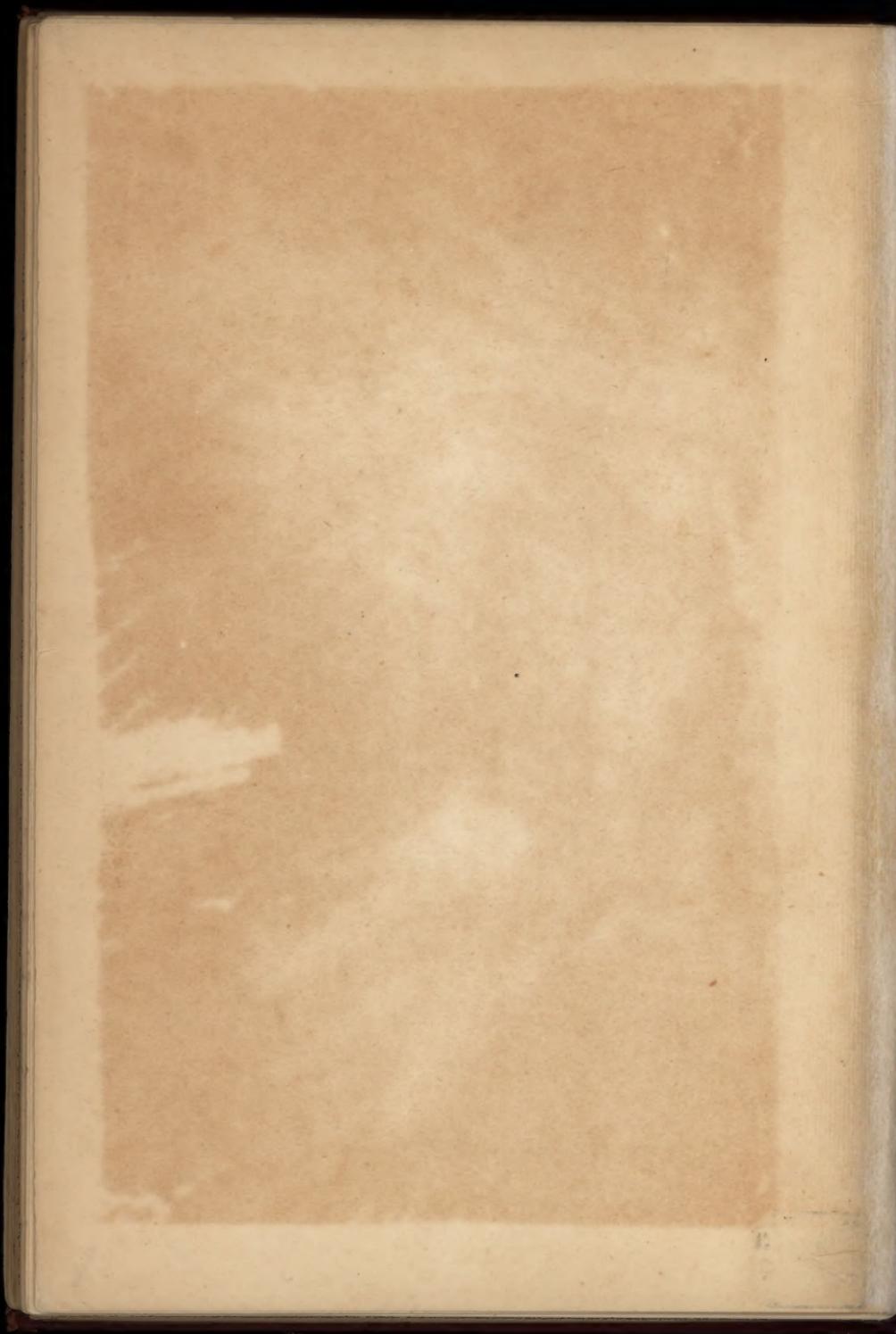
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